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NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

Analytical Chemistry

Refer also to abstract 34842.

33626 (UCRL-50006-70) 1969 ANALYTICAL CHEMISTRY ANNUAL REPORT. Harrar, J. E. (comp. and ed.) (California Univ., Livermore. Lawrence Radiation Lab.). 8 Apr 1970. 71p. Dep. CFSTI.

A summary is presented of the unclassified research and development activities in analytical chemistry during 1969. Topics discussed include computer-automated methods for mass spectrometry, vacuum fusion analyses, atomic absorption spectrophotometry, and spectrographic plate reading; surface analysis techniques involving Auger and spark source mass spectrometry; studies in emission, microwave, x-ray fluorescence, luminescence, and electron microprobe spectroscopy; minicomputer software development and applications; wet chemical methods for organic and inorganic substances; controlled-potential coulometry; gas chromatography; high resolution mass spectrometry; methods for the determination of moisture in rocks by microwave spectroscopy and calorimetry; and the application of these techniques to specific problems of the laboratory. (auth)

Chemical and Spectral Procedures

Refer also to abstract 36026.

33627 (ARH-1528) PLUTONIUM ASSAY EVALUATIONS: PLUTONIUM NITRATE SOLUTIONS. Puryear, D. A. (Atlantic Richfield Hanford Co., Richland, Wash. Separations Chemistry Lab.). Dec 1969. 27p. Dep. CFSTI.

Eight plutonium assay methods common to the nuclear industry were tested and evaluated for measuring plutonium content in nitric acid solutions. Special equipment is described, as well as the detailed techniques for each method. Observations on particular problem areas in each method are noted and discussed. The most promising of the eight methods is the cerium titration by constant-current potentiometry in nitric matrix–argentic oxidation–ferrous reduction. Recoveries and precision of the averages at the 95% confidence level are presented for each method and graphically compared to show how results vary between different methods. (auth)

33628 (NIM-499) DETERMINATION OF MOLYBDENUM BY ATOMIC-ABSORPTION SPECTROPHOTOMETRY. Steele, T. W.; Myburgh, J. L.; Mallett, R. C.; Pearton, D. C. G. (National Inst. for Metallurgy, Johannesburg (South Africa)). 9 May 1969. 5p. Dep. CFSTI (U. S. Sales Only).

The method was developed for determination of Mo in ores and rocks. The Mo is oxidized with nitric acid and potassium chlorate and then treated with hydrochloric acid. After filtration, the filtrate is diluted to a suitable volume in 2% ammonium chloride and 2% nitric acid. The Mo concentration is calculated by comparison with standard Mo solutions measured in a nitrous oxide and acetylene flame. (M.C.G.)

33629 SIMULTANEOUS DETERMINATION OF THE RARE EARTH ELEMENTS La, Ce, Pr, Nd, Sm, Eu (OR Gd) BY CHROMATOGRAPHY ON A CATION EXCHANGE RESIN. Quinche, J. P.; Quinche-Sax, S.; Thonney, M. (Station Federale de Recherches Agronomiques, Lausanne, Switzerland). Chim. Anal. (Paris); 52: 400-9(Apr 1970). (In French).

The simultaneous determination of the rare earth elements La, Ce, Pr, Nd, Sm, and Eu (or Gd) is carried out by displacement chromatography on a cation exchange resin. The eluent is an ammoniacal solution of N-(2-hydroxyethyl)iminodiacetic acid (pH = 8.80 for 25°C). The cations Li^+, Na^+, K^+, Rb^+, Cs^+, Ag^+, Sn^{2+}, Fe^{2+}, Co^{2+}, Pd^{2+}, Cd^{2+}, Cr^{3+}, Al^{3+}, and Sn^{4+} may produce various disturbances. (France)

33630 OXYGEN AND CARBON ISOTOPE RATIOS OF SOME HYDROTHERMAL CARBONATES. Sharma, S. K.; Sharma, T. (Indian Inst. of Tech., Kanpur). J. Mass Spectrom. Ion Phys.; 4: No. 1, 69-74(Apr 1970).

The $^{18}O/^{16}O$ and $^{13}C/^{12}C$ ratios were determined for calcite samples of hydrothermal origin from the Ranchi area (India). The isotopic ratios are indicative of fractional crystallization as evidenced by the gradual increase of $^{18}O/^{16}O$ ratios with decreasing temperature of carbonate crystallization. However, there is no correlation between the $^{13}C/^{12}C$ and $^{18}O/^{16}O$ ratios. The absence of correlation may possibly be due to the exchange of the carbonate carbon with the surroundings. (auth)

33631 METHODS FOR CORRECTION FOR RESIDUES APPLICABLE TO THE DETERMINATION OF ISOTOPIC RATIOS FOR VERY SMALL QUANTITIES OF GAS FOR ANALYSIS. Donville, B.; Pagani, A. (Faculte des Sciences, Toulouse). J. Mass Spectrom. Ion Phys.; 4: No. 1, 87-9(Apr 1970). (In French).

Two methods are presented for the calculation of corrections for the determination of isotopic ratios, $^{40}Ar/^{36}Ar$. The correction is necessary because of gaseous residues which interfere with the analysis of samples of small quantities. The methods are based on the preliminary introduction of the gas being analyzed at the least partial pressure permitting the measurement of the constituents. (J.G.B.)

Isotopic Procedures

33632 PREPARATION OF METALLIC NIOBIUM AND TANTALUM BY REDUCTION OF THEIR PENTACHLORIDES USING A LARGE EXCESS OF ZINC. Jangg, G.; Kieffer, R.; Topic, P. (Technische Hochschule, Vienna). Monatsh. Chem.; 100: 379-84(Jan-Feb 1969). (In German).

If niobium or tantalum pentachloride is reduced with zinc in great excess according to the auxiliary-metal-bath-process, melts of zinc metal and of zinc chloride are obtained. The molten zinc metal contains the niobium and tantalum metal. All nonmetallic impurities are found in the molten zinc chloride. The niobium and tantalum metal can be gained from the niobium– or tantalum–zinc alloy, which can easily be separated from the molten zinc chloride by distillation of the zinc. Dissolving of the zinc with acids was not successful, because acid-resistant niobium– or tantalum–zinc compounds remain, which however are oxidized on the surface. If the zinc is distilled from these compounds, the obtained metals are less pure. In order to protect the very fine and reactive metal particles, remaining after the distillation of the zinc, from a subsequent oxidation by air, wetting with toluene is useful. (auth)

33633 MASS-SPECTROMETRIC DETERMINATION OF METAL CHELATES. II. QUANTITATIVE DETERMINATION OF COPPER AT THE NANOGRAM LEVEL, USING THE ISOTOPE DILUTION METHOD. Terlouw, J.; de Ridder, J. (Utrecht Univ.). Z. Anal. Chem.; 250: 166-8(1970).

A method was developed for the determination of copper as copper acetylacetonate. The copper-65 labeled chelate acts as an

internal standard. The accuracy and reproducibility in the nanogram range are comparable with those of the ligand labeling method (2% relative accuracy). The method can be easily extended to the determination of other polyisotopic metals for which an enriched stable isotope is obtainable. (auth)

Radiometric Procedures

Refer also to abstracts 33775, 33910, 33912, and 34028.

33634 APPLICATION OF INTERNAL ELECTROLYSIS WITH SEPARATE COMPARTMENTS IN RADIOCHEMICAL ANALYSIS. II. SEPARATION OF CERTAIN FISSION PRODUCTS. van Kote, Francis; Catonne, Jean-Claude. Radiochim. Acta; 13: 145-9 (1970). (In French).

Ag, Cd, and Te can be separated from an aqueous solution with a high content of sodium chloride by internal electrolysis, if the operating parameters are chosen properly. In view of these results, a scheme of fission product separation is proposed that is based on the same method. Ag, Pd, Cd, and Sb are separated from a 5M NaCl fission product solution containing semimicro amounts of their inactive carrier substances. The complete radiochemical purification requires conventional chemical methods of treatment. (auth)

33635 APPLICATION OF INTERNAL ELECTROLYSIS WITH SEPARATE COMPARTMENTS IN RADIOCHEMICAL ANALYSIS. I. CRITICAL STUDY OF VARIOUS PARAMETERS. van Kote, Francis; Catonne, Jean-Claude. Radiochim. Acta; 13: 139-44 (1970). (In French).

A simple and economical apparatus was designed to determine the conditions under which precipitates can be produced quickly and selectively by internal electrolysis with separate anode and cathode chambers. The electrolytic precipitation of Ag, Cd, and Te separately and as a mixture in 5M NaCl as the medium was investigated systematically by means of radioelements. A critical survey of the individual parameters—type of carrier electrolyte, type of cathode, load resistance, temperature, and pH—showed that a quick, selective, and quantitative separation of the three elements investigated is possible by this method and may be a valuable tool of radiochemical analysis. (auth)

33636 NEUTROGRAPHIC HYDROGEN DETERMINATION IN ZIRCONIUM ALLOYS. Klepfer, H. H. (General Electric Co., San Jose, Calif.); Kosanke, H. D.; Esch, E. L. ASTM (Amer. Soc. Test. Mater.) Spec. Tech. Publ.; No. 458, 372-85(1969).

From Symposium on Applications-Related Phenomena in Zirconium and Its Alloys, Philadelphia, Pa. See ASTM-STP-458; CONF-681105.

In the course of post-irradiation examinations of Zircaloy-2 clad fuel rods, it was recognized that it might be possible to detect hydriding of the cladding by using neutron radiography. Experiments were performed by applying indirect transfer methods for neutron radiography since direct exposure with a photographic film would not be appropriate with highly radioactive specimens. After neutron irradiation, dysprosium indirect transfer screens were put in contact with x-ray film for approximately 24 hr. The x-ray film negatives were analyzed with a densitometer. Neutron radiography was shown to be effective for detection of hydrogen in thin-walled Zircaloy-2 tubing to a lower limit of 500 to 700 ppM. Using a densitometer of 1 percent precision, a sensitivity of about ±400 ppM through the center of the tube and ±200 ppM through the wall of the tube at the 1000-ppM level was obtained. The neutrographic technique was also used to detect local concentrations of zirconium hydride in irradiated Zircaloy-2 fuel cladding which were not identifiable by other non-destructive means. The method, though not sensitive below 500 ppM hydrogen, was, nevertheless useful. Using neutron radiography, it was possible to determine whether chemical analyses gave values representative of the hydrogen concentration in an entire fuel rod; the complete distribution of hydrogen in the cladding could be determined. (auth)

33637 LOW-BACKGROUND BETA-SCINTILLATION METHOD OF MEASURING LOW ACTIVITIES IN RADIOCHEMISTRY. Dimchev, T.; Marinov, V. (Inst. of Physics, Sofia). Compt. Rend. Acad. Bulg. Sci.; 23: 261-4(1970).

Results from experiments on a low-background method for the measurement of ^{90}Y and ^{137}Cs with thin plastic scintillators are reported. The method has been used for the determination of contamination in food products with an accuracy of 9.3%. (J.G.B.)

33638 APPLICATION OF REAGENT PAPER TO THE PREPARATION OF SAMPLES FOR BETA ACTIVITY MEASUREMENTS. Fukuda, Katsuaki; Sugiyama, Kasuyuki; Mizuike, Atsushi (Nagoya Univ., Japan). Radioisotopes (Tokyo); 19: 247-9(May 1970).

A reagent paper (dithizone paper) was successfully applied to the measurement of β activity of ^{210}Bi. The paper was prepared by impregnating filter paper with dithizone. The effects of various reagent variables on the measurement of ^{210}Bi are discussed. The reproducibility of this method was found to be better than that obtained by coprecipitation. (B.L.M.)

33639 NONDESTRUCTIVE TESTING OF THE NUCLEAR FUEL CONTENT OR BURNOUT OF FUEL SAMPLES OR REACTOR FUEL ELEMENTS. Dieck, E. L. VDI (Ver. Deut. Ing.) Z.; 111: 1076(1 Aug 1969). (In German).

Post-irradiation under defined conditions gave short-life fission products in addition to those already present. Subtracting gamma spectra after varying waiting times resolved photolines of short-life fission products and the photographic yield with data of post-radiation gave the simple fission product content. Integral measurements of the decrease of activity of short-life fission products after short post-irradiation were later made and comparison with known amounts of fission products gave fission product content and burnout. Application to the burnout determination of pebble bed reactor fuel elements is detailed. (Fuel Abstr.)

33640 DETERMINATION OF PERCENT BURNUP OF FUEL BY RADIOCHEMICAL METHOD WITH THE AID OF ^{137}Cs AND ^{144}Ce. Krtil, Josef; Bezdek, Miloslav (Inst. of Nuclear Research, Rez, Czech.). Jad. Energ.; 16: 181-8(Jul 1970). (In Czech).

The determination of percent burnup based on the isolation of ^{137}Cs and ^{144}Ce and measurement of their absolute activity was studied. On the samples of irradiated materials the separation methods for isolation of ^{137}Cs and ^{144}Ce and suitable radiometric methods for measuring absolute activity were verified. The separation and measuring methods described permit the percent burnup, to be determined with an error of ±4.7 and ±5.8%, with ^{137}Cs and ^{144}Ce, respectively. (auth)

33641 STATISTICAL ANALYSIS OF DATA FROM COUNTER-CURRENT DISTRIBUTION. V. THE ISOTOPE EFFECT. Kirdani, Rashad Y.; Priore, Roger L. (Roswell Park Memorial Inst., Buffalo). Anal. Biochem.; 35: 13-22(May 1970).

Given enough transfers, many mixtures of compounds, identical except for having two different isotopic labels or one compound unlabeled, can be separated. Quantitation of this isotope effect is then essential if mixtures of isotopic compounds are to be used for identification. β values (K_{higher}/K_{lower}) were found in the examples examined to be within the range of 1.01. Therefore, if on separate distributions of a compound pair and their derivatives (e.g., acetates) there is obtained approximately the same low β value, identity is then established to a high degree of probability. (auth)

33642 METHOD FOR MULTIPLE ANALYSES OF CONCENTRATION AND SPECIFIC RADIOACTIVITY OF INDIVIDUAL AMINO ACIDS IN NERVOUS TISSUE EXTRACTS. Shank, R. P.; Aprison, M. H. (Indiana Univ. Medical Center, Indianapolis). Anal. Biochem.; 35: 136-45(May 1970).

A procedure is described for the analysis of the concentration and specific radioactivity of amino acids present in moderate to large amounts (>0.4 μmole/g) in nerve tissue extracts. These amino acids can be analyzed in as little as 10 mg of fresh nerve tissue. The procedure is less time consuming than other methods with similar objectives. (auth)

33643 RADIOISOTOPIC ASSAY SYSTEM FOR ENZYMES OF THE ORNITHINE-UREA CYCLE. Rowe, W. C.; Huggins, A. K.; Baldwin, E. (University Coll., London). Anal. Biochem.; 25: 167-76(May 1970).

A radioisotopic method for the assay of carbamoylphosphate synthetase, ornithine transcarbamoylase, argininosuccinate synthetase, and arginase is described. The method is based on the two-dimensional paper chromatographic separation of ^{14}C-labeled reactants and products for each specific reaction. The percentage conversion of substrate is determined from the ratio of the total dpm in the product and the sum of the total dpm in the product plus the total dpm in the residual substrate. Advantages of this method over existing colorimetric ones are: sensitivity, small size of tissue samples required, lack of interference from material present in enzyme extracts, and permanent record of results if required. (auth)

33644 SIMPLE RADIOACTIVITY RECORDING SYSTEM FOR COLUMN CHROMATOGRAPHY OF ^{32}P-LABELED PRODUCTS. Jordan, B. R. (Centre de Biologie Moleculaire, Marseille). Anal. Biochem.; 35: 244-8(May 1970).

A radioactivity recording system is described, which significantly reduced the labor involved in routine preparation of ^{32}P-

labeled fractions. It is limited to high-energy beta emitters. (M.C.G.)

33645 IMPROVEMENT IN A PROCEDURE FOR COUNTING TRITIUM AND ^{14}C IN POLYACRYLAMIDE GELS. Zaitlin, Milton; Hariharasubramanian, V. (Univ. of Arizona, Tucson). Anal. Biochem.; 35: 296-7(May 1970).

A procedure developed by Basch (Anal. Biochem., 26: 184(1968)) was modified by adding a small amount of water to the NCS reagent, thus overcoming the swelling difficulties. (M.C.G.)

33646 RADIOACTIVE ASSAY OF FOLIC ACID POLYGLUTAMATE CONJUGASE(S). Krumdieck, Carlos L.; Baugh, Charles M. (Univ. of Alabama, Birmingham). Anal. Biochem.; 35: 123-9(May 1970).

The development of a new nonmicrobiological assay for conjugases (pteroylglutamyl-γ-glutamyl peptidases) is reported. This method is comparable in sensitivity to the microbiological procedures, and may be modified to exceed that sensitivity. With the judicious use of selectively positioned glutamic acid-^{14}C residues in the substrates, the procedure described allows the determination of preferred substrates and end products. (auth)

33647 FILTER PAPER METHOD FOR MONITORING RADIOACTIVITY IN SUCROSE DENSITY GRADIENTS. Timourian, H.; Watchmaker, G. (Univ. of California, Livermore). Anal. Biochem.; 35: 87-90(May 1970).

A slowly moving strip of chromatography filter paper receives the contents of a sucrose density gradient after the separation of macromolecules by centrifugation. Radioactivity along the strip can be measured by cutting the strip in lengths of 3 to 6 in., rolling these, and placing them in vials for counting in a liquid scintillation counter. Counting efficiencies for ^{14}C and tritium are discussed. (M.C.G.)

33648 STATISTICAL ANALYSIS OF DATA FROM COUNTER-CURRENT DISTRIBUTION. IV. IDENTIFICATION OF COMPOUNDS. Kirdani, Rashad Y.; Priore, Roger L. (Roswell Park Memorial Inst., Buffalo). Anal. Biochem.; 35: 1-12(May 1970).

Investigation of the identity of an unknown with a standard can be conveniently performed by codistribution of the two compounds, labeled with different isotopes or one being unlabeled. The method was found successful in arriving at match decisions in cases in which identical compounds were used, and to at no-match verdicts when nonidentical compounds were codistributed. The limit of the method is reached when separation between peak tubes for the two curves is between 0.5 and 1.0 tubes. Minor impurities are tolerated. The method was specifically developed for identification of highly polar compounds such as conjugates. (auth)

Activation Procedures

Refer also to abstracts 33991 and 34985.

33649 (CEA-CONF-1520) USE OF NUCLEAR REACTIONS TO DETERMINE THE QUANTITY OF IMPURITIES IN SEMICONDUCTORS. Legeon, Emile; Bontemps, Andre; Fontenille, Jean; Guernet, Georges (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Feb 1970. 9p. (In French). (CONF-700414-1). Dep. CFSTI (U. S. Sales Only).

From International Conference on Advanced Microelectronics, Paris, France.

It is shown that nondestructive measurements of impurities in a semiconducting sample can be made through nuclear reactions. As an example, boron concentration in a silicon sample was determined, using the $^{11}B(p,\alpha)$ reaction at low energy. (auth)(France)

33650 (NYO-3778-9) PROGRESS REPORT IV [ON NEUTRON ACTIVATION ANALYSIS], ANNUAL, MAY 1, 1969-APRIL 30, 1970. Maletskos, Constantine J. (New England Deaconess Hospital, Boston, Mass. Cancer Research Inst.). Contract AT(30-1)-3778. 81p. Dep. CFSTI.

Further studies were made of the method of removing specific interferences from activated samples by a heterogeneous isotopic exchange reaction in a column using an organic solvent for elution. Sample handling procedures and other operations related to sampling and sample handling, irradiation, and measurement were studied. In particular, the work includes an assessment of tissue contamination when using scalpels for sample cutting, the cleaning of polyethylene vials using a small ball mill and compared to ultrasonic cleaning, methods of grinding salts for separation columns, and flux mapping in the irradiation containers. Tissue analyses on normal uterine muscle and fibroids growing in it are described. Uses of tissue results are considered from a statistical standpoint. Computer programs are described briefly. Some preliminary experiments on in vivo activation of rats using the slow neutron beam in the Medical Therapy Room, Massachusetts Institute of Technology Reactor, are described. Measurements were made both with NaI(Tl) and Ge(Li) detectors. The results show that such activation of small animals is quite feasible and that reproducibility and uniformity of irradiation can be achieved with relatively simple and inexpensive improvements. (auth)

33651 A SIMPLE METHOD OF NEUTRON ACTIVATION ANALYSIS FOR MERCURY. Steinnes, E. (Inst. for Atomenergie, Kjeller, Norway). Nord. Hyg. Tidskr.; 50: 71-4(1969). (In Norwegian).

A method was developed for separation of ng amounts of mercury as the sulfide from a low-concentration ammonium hydroxide solution. It offers an effective separation from ^{24}Na and ^{32}P, which are the dominating radioisotopes in biological materials. The yield of the method is close to 100%. The weight of the samples was determined and they were encapsuled in a silica ampoule followed by irradiation for three days with a neutron flux of 2×10^{12}. Thereafter the samples were stored for another three days for decay of short-lived sources. The samples were stirred with a mixture of nitric acid, sulfuric acid, and mercury carriers, in an apparatus for decomposition. A pH of 8-9 was obtained by adding ammonium hydroxide, and mercury sulfide was precipitated with thioacetamide. The solution was stored for two hours and filtered. The gamma activity from ^{197}Hg was measured on a multichannel gamma spectrometer. The method proved to be satisfactorily selective for all samples of biological origins that were analyzed. (S.W.)

33652 RECENT EXPERIENCES WITH ACTIVATION ANALYSIS. Ljunggren, Knut; Sjoestrand, Bernt; Hagman, Daisy; Westermark, Torbjoern. Nord. Hyg. Tidskr.; 50: 75-7(1969). (In Swedish).

A method was developed for activation analysis of higher sensitivity and for analysis of samples when standard techniques do not suffice. To determine concentrations below 0.1 ng/g the volume of the irradiated sample had to be increased from 0.3 to 10 ml. A sensitivity limit of 0.03 ng/g was obtained. To separate suspended particles, 60 ml were centrifuged at 2.500 g for 15 min. Rock, mineral, and ore samples were dissolved in fluoride with mercury carrier, which decreased the yield to 10 to 90%. The concentration figures are shown to be independent of the yield. (S.W.)

33653 DETERMINATION OF NIOBIUM BY PHOTON-ACTIVATION ANALYSIS BASED ON INTERNAL-REFERENCE METHOD. Oka, Yoshinaga; Pung, Tong-chuin; Saito, Tatsuya (Tohoku Univ., Sendai). Bull. Chem. Soc. Jap.; 43: 1083-7(Apr 1970).

The internal-reference method proposed previously was applied to the photon-activation analysis of niobium using molybdenum as the reference element. For determination of niobium, ^{92m}Nb produced by the (γ,n) reaction was utilized and ^{93m}Nb or ^{96}Nb activities coming from molybdenum by the (γ,p) processes were used as reference. A series of molybdenum and niobium mixtures with known compositions were irradiated by bremsstrahlung photons with a maximum energy of 17 MeV for an hour. After niobium activities were separated chemically, the γ spectra were measured with a lithium-drifted germanium detector. A good proportionality was obtained between the activity ratio, $R_{A\rho}$, and the weight ratio, R_W. Niobium down to 50 μg can be determined with a relative error within ±3% under the present experimental conditions. (auth)

33654 OPTIMUM GEOMETRIC POSITION FOR RADIOACTIVATION BY FAST NEUTRON WITH A NEUTRON GENERATOR. Kishikawa, Toshiaki; Shinomiya, Chiro (Kumamoto Univ., Japan). Bull. Chem. Soc. Jap.; 43: 1056-61(Apr 1970).

With a 14-MeV neutron generator the optimum irradiation position of disk or square samples of appropriate numbers are given as a function of the configuration of the sample relative to the source. Calculated values are compared with experimental data. (auth)

33655 DETERMINATION OF COPPER, ARSENIC, AND MERCURY IN CIGARETTES BY NEUTRON ACTIVATION ANALYSIS. Maruyama, Yoshiaki; Komiya, Kazuhide; Manri, Teruo (Musashi Inst. of Tech., Kawasaki, Japan). Radioisotopes (Tokyo); 19: 250-2(May 1970).

Irradiated cigarette samples were decomposed with a mixture of $HNO_3-H_2SO_4$; Hg and As were separated by distillation and then precipitated as the sulfides. Copper was also precipitated as the sulfide. The chemical yield in the separation was ~80% for the elements, and the sensitivity limits were 0.04 μg for Cu, 0.03 μg for As, and 0.08 μg for Hg. The analytical results for various cigarettes are tabulated. The Hg content of Japanese cigarettes (0.70 ppM) was much higher than that for foreign cigarettes

(0.16 ppM). This high content is attributed to the use of Hg compounds as pesticides on tobacco farms. (B.L.M.)

33656 APPLICATION OF 14-MeV NEUTRON GENERATOR TO HYDROGEN DETERMINATION IN HYDROCARBONS. Tamura, Mituhisa; Yamamoto, Tadato (Government Resources Research Inst., Kawaguchi, Japan). Radioisotopes (Tokyo); 19: 223-8 (May 1970). (In Japanese).

As a novel application of a 14-MeV neutron generator, the possibilities of hydrogen determination in hydrocarbons with recoil protons are discussed. High-energy-recoil protons are produced from the collisions of the fast neutrons against the hydrogen nuclei. A mixture of hydrocarbon and boric oxide (B_2O_3) powder which has a large activation cross section for the protons was irradiated with the fast neutrons, and the activity of the powder was counted after removing the hydrocarbon from the powder. The half-life of the boric oxide was about 20 min. This fact suggests that the reaction would mainly be caused by $^{11}B_5(p,n)\ ^{11}C_6$. The specific activity (A) of the boric oxide is shown as follows: $A = k\rho W_H$ where k is constant, ρ is hydrocarbon density, and W_H is weight fraction of hydrogen in hydrocarbon. It would be possible to obtain the hydrogen content by the measurement of A, because a simple estimation of ρ with a hydrometer can be done. (auth)

33657 STUDIES ON (γ,γ') REACTIONS: RECENT DEVELOPMENTS AND PROBLEMS. Yoshihara, Kenji (Tohoku Univ., Japan). Nippon Genshiryoku Gakkaishi; 12: 266-75(1970). (In Japanese).

A review is presented on the developments achieved and problems encountered in recent studies on (γ,γ') reactions. One such development is the utilization of these reactions in activation analysis, using accelerators and ^{60}Co γ sources. The sensitivity of the method can be enhanced by increasing the dose rate. The technique is becoming increasingly accepted as a routine method for certain constituent elements. Dosimetry is another very interesting new field of application of the (γ,γ') reaction, and can be used for measuring quite high dose rates. The most recent developments have made it possible to determine high dose rates extremely rapidly by means of (γ,γ') dosimetry. The prominent advantages of this method are its freedom from limitations to the measurable dose and its independence from ambient temperature. The (γ,γ') reaction can also be applied to dosimetry of electrons in accelerators and to calibration of ^{60}Co γ sources. It has been found that studies in the chemical effects of the (γ,γ') reaction are very important in the field of solid hot-atom chemistry. The "appearance energy" for the hot-atom effect was first observed in the system of an In-EDTA complex salt. (auth)

33658 DETERMINATION OF THE OXYGEN CONTENT OF ALUMINIUM BY 14-MeV NEUTRON ACTIVATION. EFFECTS OF SURFACE REMOVAL AFTER IRRADIATION. Dugain, F. (Centre de Recherches, Pechiney, France); Andre, M.; Speecke, A. Radiochem. Radioanal. Lett.; 4: 35-41(3 Jun 1970).

Surface treatment of the sample after irradiation, by etching with a sodium hydroxide solution, decreases the apparent content of oxygen, whatever the method of preparation of the sample surface prior to irradiation, or the nature of the gas around the sample during irradiation. Values as low as 2 $\mu g/g$ O_2 were obtained for common metals. (auth)

33659 TOTAL BODY BROMINE: ESTIMATION BY OCCUPANCY PRINCIPLE AND NEUTRON ACTIVATION ANALYSIS. Gillespie, F. C.; Shimmins, J.; Lenihan, J. M. A. (Western Regional Hospital, Glasgow). Radiochem. Radioanal. Lett., 4: 43-9(3 Jun 1970).

The total-body content of bromine was measured in two human subjects. The method used employed neutron activation analysis and the concept of occupancy. This new method may be used to measure the total-body content of many elements. (auth)

33660 DETERMINATION OF NICKEL IN ASPHALTS BY NEUTRON ACTIVATION ANALYSIS. Rakovic, M. (Texas A and M Univ., College Station). Radiochem. Radioanal. Lett.; 4: 59-63(3 Jun 1970).

A method is presented for determining nickel in asphalts by activation of samples with neutrons, addition of Ni(II) carrier, decomposition using sulfuric and nitric acids, separation of nickel(II) dimethylglyoximate, and measurement using a multichannel γ-ray spectrometer with NaI(Tl) crystal. (auth)

33661 ACTIVATION ANALYSIS OF RARE EARTHS IN NUCLEAR REACTOR FUELS. Baechmann, K.; Lieser, K. H. (Technische Hochschule, Darmstadt, Ger.). Z. Anal. Chem.; 250: 172-8(1970). (In German).

The rare earths are separated by extraction from uranium and thorium. After irradiation with thermal neutrons (together with standard samples) and addition of carrier they are separated in a cation-exchange column. Activity measurements are followed by determination of the amount of the individual rare earth by spectrophotometry. The distribution of the rare earth elements in the samples is compared with the geochemical distribution. The different methods for the determination of the rare earth elements are discussed. (auth)

33662 NONDESTRUCTIVE RADIOACTIVATION ANALYSIS OF Al CANS USED FOR IRRADIATIONS IN THE RA REACTOR AT VINCA, YUGOSLAVIA. Kakas, M.; Marinkov, L.; Draskovic, R. (Boris Kidric Inst. of Nuclear Sciences, Vinca, Yugoslavia). Radiochim. Acta; 13: 75-81(1970).

Impurities in Al cans (produced from aluminum of 99.8% purity) used for sample irradiations in the RA reactor at Vinča, Yugoslavia, were qualitatively and quantitatively determined by nondestructive radioactivation analysis. The following impurities were determined: Ga, Co, Fe, Zn, Cr, Sc, and Cu. The presence of Mn and Na was also proved but their concentration was not determined because of the specific conditions. A qualitative analysis was also made of the contaminants of these cans, which result from the contamination during irradiation in the RA-reactor and repacking of cans in a special cell. The presence of the following radioisotopes: ^{24}Na, $^{198,199}Au$, ^{187}W, $^{122,124}Sb$, ^{140}La, ^{58}Co, ^{46}Sc, ^{65}Zn, ^{192}Ir, ^{51}Cr, and ^{59}Fe was also proved in the smears by the method of radioactivation analysis. (auth)

Inorganic, Organic, and Physical Chemistry

Refer also to abstracts 33632, 33641, 33750, 33769, 34058, 34902, 34903, 34931, and 35892.

33663 (UR-3999-9) FUNDAMENTAL STUDIES IN ISOTOPE CHEMISTRY. Progress Report, July 1, 1969–June 30, 1970. Bigeleisen, Jacob (Rochester Univ., N. Y.). Contract AT(30-1)-3999. 36p. Dep. CFSTI.

Topics covered include: molal volumes of the isotopic homologues of ethylene, vapor pressures of ^{36}Ar and ^{40}Ar, and correlations of isotope effects with molecular forces. (M.C.G.)

33664 NUCLEAR QUADRUPOLE COUPLING TENSOR IN DIBROMOMETHANE FROM ITS MICROWAVE SPECTRUM. Chadwick, D.; Millen, D. J. (University Coll., London). Chem. Phys. Lett.; 5: 407-9(15 May 1970).

Rotational constants were obtained for two isotopic species of dibromomethane: $CH_2{}^{79}Br_2$ and $CH_2{}^{81}Br_2$. The nuclear quadrupole coupling tensor in $CH_2{}^{79}Br_2$ is determined to be $\chi_{aa} = 346 \pm 20$ MHz, $\chi_{bb} = -31 \pm 10$ MHz, $\chi_{cc} = -315 \pm 10$ MHz, $\chi_{ab} = 410.5 \pm 5$ MHz, and $\chi_{ac} = \chi_{bc} = 0$. (auth)

33665 LASER RAMAN STUDY OF QUASI-SPIN WAVE HYDROGEN TUNNELING MODES IN KH_2PO_4 AND KD_2PO_4. Lavrencic, B.; Levstek, I.; Zeks, B.; Blinc, R.; Hadzi, D. (Univ. of Ljubljana, Yugoslavia). Chem. Phys. Lett.; 5: 441-4(15 May 1970).

The low-frequency laser-excited Raman spectra of KH_2PO_4 and KD_2PO_4 single crystals were measured at room temperature for various orientations and a complete symmetry assignment of the observed modes was made. In addition to the strongly damped "ferroelectric" quasi-spin wave-like proton mode of symmetry B_2 observed by Kaminov, a non-degenerate proton mode at 397 cm^{-1} and a double degenerate proton mode around 80 cm^{-1} of predicted symmetry properties were found. The frequencies of all these proton modes are reduced on deuteration by a factor of ten or more, thus demonstrating their collective proton tunneling nature. (auth)

33666 INTERMOLECULAR TRIPLET ENERGY TRANSFER. II. FROM BENZENE, ACETONE, AND BIACETYL TO π-BONDED MOLECULES. Schmidt, Manfred W.; Lee, Edward K. C. (Univ. of California, Irvine). J. Amer. Chem. Soc.; 92: 3579-86(17 Jun 1970).

The relative rates of the triplet electronic energy transfer from benzene to olefinic hydrocarbons (mono- and diolefins) and CS_2 were measured in competition with cis-trans isomerization of cis-2-butene in the gas phase. In some cases, deuterated olefinic acceptor molecules were used and varying degrees of deuterium isotope effects on rate were observed. The rates of the triplet electronic energy transfer from acetone and biacetyl to some π-bonded molecules were also measured by the quenching of the direct phosphorescence emission. So far, CS_2 is found to be the most efficient quencher of the triplet benzene and acetone. These

and other rate-energetics data are discussed in reference to existing mechanistic models of triplet energy transfer processes. (auth)

33667 STEREOCHEMISTRY OF TROPOLONATO COMPLEXES UTILIZING THE HIGHER COORDINATION NUMBERS. I. NINE-COORDINATE TETRAKIS(TROPOLONATO)(-N,N'-DIMETHYLFORMAMIDETHORIUM(IV). Day, V. W.; Hoard, J. L. (Cornell Univ., Ithaca, N. Y.). J. Amer. Chem. Soc.; 92: 3626-35(17 Jun 1970).

Molecular crystals of (DMF)Th_4 (DMF is N,N'-dimethylformamide, T^- is the bidentate $C_7H_5O_2^-$ tropolonate ion) utilize a two-molecule unit cell, space group $P\bar{1}$, having a = 15.222 (9), b = 10.922 (6), c = 9.452 (5) Å, α = 113.40 (1), β = 96.40 (2), γ = 87.53 (2)°. The intensities of 7476 independent reflections having (sin θ)/$\lambda \leq 0.69$ were measured with Mo Kα radiation by the $\theta-2\theta$ scanning technique on an automated Picker four-circle diffractometer; the 6792 data statistically retained as observable were employed for structure determination and anisotropic refinement to an R of 0.047; all hydrogen atoms were directly placed. The nine-coordinate (DMF)ThT_4 molecule in the crystal approximates closely to C_s-m symmetry; it occurs as one of seven theoretical stereoisomers that utilize the monocapped square antiprism as coordination polyhedron. One tropolonato ligand spans a slant edge of the pyramidal cap while the monodentate ligand takes the one other vertex, also in the cap, that allows retention of C_s symmetry. A second tropolonato ligand spans the basal edge of the polyhedron opposite to the monodentate ligand, and the two other tropolonato ligands span a mirrored pair of lateral edges of the polyhedron. Dimensional variations from the ideal C_{4v} geometry of the polyhedron are required by the small "bite" of the tropolonato ligand (2.52–2.56 Å); inter-ring O···O contacts range upward from 2.79 Å. The length of the Th–O bond to the apical oxygen, 2.485 (5) Å, is significantly greater than the average, 2.445 Å, for the other seven bonds to tropolonato oxygen; the bond to the uncharged DMF ligand at 2.519 (6) Å is still longer. Bond parameters in the tropolonato ligands compare favorably with those reported from simpler structures. (auth)

33668 HYDROGEN SCRAMBLING IN ORGANIC IONS AS A FUNCTION OF INTERNAL ENERGY. EXTENSION OF THE ENERGY RANGE. Howe, I.; McLafferty, F. W. (Cornell Univ., Ithaca, N. Y.). J. Amer. Chem. Soc.; 92: 3797-9(17 Jun 1970).

It is reported that secondary decompositions can provide information on molecular ions formed with a variety of internal energies. Relative losses of OD and OH as a function of internal energy in benzoic acid were measured. The decomposition of toluene and deuterated toluene was also studied. (M.C.G.)

33669 KINETICS AND MECHANISM OF THE SULFOXIDE–SILANE REACTION. Chan, T. H.; Melnyk, A. (McGill Univ., Montreal). J. Amer. Chem. Soc.; 92: 3718-22(17 Jun 1970).

The kinetics of the reaction between aromatic sulfoxides and trichlorosilane were examined. The reaction follows the rate equation, rate = k [sulfoxide][trichlorosilane]. The solvent and the substitution effect were investigated. An isotope effect of $k_H/k_D = 2.0-2.4$ was observed. The activation parameters are $\Delta H^\ddagger = 7.1 \pm 0.5$ kcal/mol and $\Delta S^\ddagger = -31 \pm 1.4$ eu. Based on these observations, a mechanism involving a four-center transition state is proposed. (auth)

33670 CYCLOPROPANE. XXVII. THE CYCLOPROPYL ANION. Motes, J. M.; Walborsky, H. M. (Florida State Univ., Tallahasse). J. Amer. Chem. Soc.; 92: 3697-99(17 Jun 1970).

The rate of hydrogen–deuterium exchange and rate of racemization of 1-benzoyl-2,2-diphenylcyclopropane (1) were investigated. The ketone 1 exhibited only a moderate degree of retention of configuration (27%), which contrasts with the high degree of retention (99%) observed with the corresponding 1-cyano-2,2-diphenylcyclopropane (2). From hydrogen–deuterium and hydrogen–tritium isotope effects, it was suggested that in both the base-catalyzed exchange and racemization reactions of 1 the rate-determining step is proton abstraction. (auth)

33671 CHEMISTRY IN SUPER ACIDS. IV. EXCHANGE OF HYDROGEN AND DEUTERIUM IN HF(DF)–SbF_5, $FSO_3H(FSO_3D)$–SbF_5, AND $H_2SO_4(D_2SO_4)$–SbF_5 SOLUTIONS. Olah, George A.; Shen, Jacob; Schlosberg, Richard H. (Case Western Reserve Univ., Cleveland). J. Amer. Chem. Soc.; 92: 3831-2(17 Jun 1970).

Data are presented on the hydrogen–deuterium exchange of molecular hydrogen and deuterium in super acid systems at room temperature as evidenced by observation of HD formation. Six systems were investigated: $H_2 + FSO_3D - SbF_5$, $H_2 + D_2SO_4 - SbF_5$, $H_2 + DF - SbF_5$, $D_2 + FSO_3H - SbF_5$, $D_2 + H_2SO_4 - SbF_5$, and $D_2 + HF - SbF_5$. (M.C.G.)

33672 CARBON SCRAMBLING IN THIOPHENE UNDER ELECTRON IMPACT. PRELIMINARY COMMUNICATION. De Jong, F.; Sinnige, H. J. M.; Janssen, M. J. (Univ., Groningen, Netherlands). Rec. Trav. Chim.; 89: 225-6(Mar 1970).

Carbon scrambling and hydrogen scrambling in thiophene labeled with carbon-13 and deuterium were studied in a mass spectrometer. It was established that isotope effects are absent and that fragmentation is a one-step process. (M.C.G.)

33673 HYDROLYSIS OF THE URANYL ION IN HEAVY WATER. Maeda, Masunobu; Kakihana, Hidetaka (Tokyo Inst. of Tech.). Bull. Chem. Soc. Jap.; 43: 1097-1100(Apr 1970).

Hydrolysis equilibria of the UO_2^{2+} ion in heavy water containing 3M $NaClO_4$ as an ionic medium were studied at 25°C by potentiometric titrations, employing a technique of constant-current coulometry. The deuterium-ion concentration was measured by means of a glass electrode. The most probable hydrolysis scheme chosen in the range of the total uranyl concentration from 1 to 10 mM was: $(UO_2)_2(OD)_2^{2+} - (UO_2)_3(OD)_3^{3+} - (UO_2)_3(OD)_5^+$; the respective stability constants were $-\log \beta_{2,2} = 6.80 \pm 0.02$, $-\log \beta_{4,3} = 1400 \pm 0.07$, and $-\log \beta_{5,3} = 18.63 \pm 0.02$. The above results reveal that the composition of the hydrolysis species in heavy water are generally the same as those in light water, while the values of the stability constants are smaller in heavy water than in light water. (auth)

33674 ZERO-POINT AVERAGE STRUCTURE OF ACETONE. Iijima, Takao (Hokkaido Univ., Sapporo). Bull. Chem. Soc. Jap.; 43: 1049-53(Apr 1970).

The zero-point average structure of acetone was determined from the moments of inertia obtained by means of microwave spectroscopy by Nelson and Pierce, as incorporated with the average distances from gas-electron diffraction by Kato, et al. In addition to the normal species $(CH_3)_2CO$, three isotopically-substituted species, $(^{13}CH_3)_2CO$, $(CH_3)_2C^{18}O$, and $(CD_3)_2CO$, were used in the analysis. The following values of the r_z-parameters were determined: C=O, 1.2122 ± 0.0025 Å; C–C, 1.5190 ± 0.0008 Å; C–H, 1.0614 ± 0.0010 Å; ∠HCH, 108°30′ ± 6′; and ∠CCC, 116°9′ ± 10′ [∠CCC for $(CD_3)_2CO$, 115°51′ ± 10]. The slightly smaller value of ∠CCC found for the deuterated species was reasonably attributed to the anharmonicity associated with the symmetric rocking motion of the two methyl tops. The equilibrium values for C–H (D) and ∠CCC were also estimated to be 1.078 Å and 115°0′ respectively. (auth)

33675 THERMAL EXPANSION IN $Na(H_{1-x}D_x)_3(SeO_3)_2$ AND ISOTOPE EFFECT. Miki, Hirohumi; Makita, Yasuharu (Tokyo Univ.). J. Phys. Soc. Jap.; 29: 143-9(Jul 1970).

Linear thermal expansions along crystallographic axes for $NaH_3(SeO_3)_2$ and $NaD_3(SeO_3)_2$, and those along the b axis for the $Na(H_{1-x}D_x)_3(SeO_3)_2$ system in the entire range of x were measured in their transition temperature regions. It is found that the replacement of hydrogen by deuterium shows a large isotope effect in saturated spontaneous strains in the [010] plane, but no isotope effect along the [010] direction. Linear thermal expansions for the crystals of the $Na(H_{1-x}D_x)_3(SeO_3)_2$ system in the range $0 < x < 0.4$ show rather complicated behavior due to the existence of three phase transitions. The phase diagram of this system shows unusual isotope effect in the transition temperatures. Present results suggest that there are strong couplings between protons (or deuteron) and lattices of Na^+ and SeO_3^{2-} ions in $NaH_3(SeO_3)_2$, (or $NaD_3(SeO_3)_2$). (auth)

33676 PREDICTION AND INTERPRETATION OF FREE-ION AND CRYSTAL-FIELD SPECTRA OF THE ACTINIDES. THE INTERMEDIATE CRYSTAL-FIELD DIAGRAM FOR $5f^2$ Np^{5+} IN OCTAHEDRAL $CsNpF_6$. Varga, L. P. (Oklahoma State Univ., Stillwater); Brown, J. D.; Reisfeld, M. J.; Cowan, R. D. J. Chem. Phys.; 52: 4233-41(15 Apr 1970).

The problem of identification and characterization of the many oxidation states of the actinide elements give rise to f–f electronic spectra is treated both for free-ion and crystal-field spectra. For free-ion, nonrelativistic self-consistent-field calculations on f^n configurations of the actinides yielded values for the Coulomb and spin–orbit interaction parameters from which electronic spectra may be predicted. Comparison of these calculated energy levels with the spectra observed for several actinides was made. Crystal-field splitting of the free-ion levels was examined in detail for the case of $5f^2$ Np^{5+} in $CsNpF_6$. A complete intermediate crystal-field coupling diagram for this f^2 configuration ion under O_h point-group symmetry was constructed and the observed spectrum was fit to the diagram confirming the predominant octahedral structure of NpF_6^-. The combined Coulomb, spin–orbit, and octahedral crystal-field spectroscopic parameters for NpF_6^- were: $E^1 = 3144$, $E^3 = 16.75$, $E^3 = 251.9$, $\zeta = 2230$, $B_2^4 = 1071$, and $B_4^4 = 551$ cm^{-1}. Application of these techniques to

other electron configurations and point-group symmetries is suggested. (auth)

33677 CONCERNING URANIUM HYDRIDE. Ermolaev, M. I. (Voronezh Technological Inst., USSR). Zh. Neorg. Khim.; 15: 607-11(Mar 1970). (In Russian).

Uranium hydride is quantitatively decomposed in the range from 456 to 460°C. By dissolution of uranium hydride in pyrophosphoric acid and thermal decomposition, it was found that is is possible to find metallic uranium in a series of uranium hydrides with decreased contents of hydrogen. It was established that uranium hydride has a composition that corresponds to the formula UH_3. (tr-auth)

33678 FORMATION OF COMPLEXES OF URANYL AND LANTHANUM IONS WITH ARSENAZO III IN PERCHLORATE SOLUTIONS. Klygin, A. E.; Zavrazhnova, D. M.; Kolyada, N. S. Zh. Neorg. Khim.; 15: 739-44(Mar 1970). (In Russian).

Spectrophotometric studies were made on the formation of complexes of uranyl and lanthanum ions with Arsenazo III in perchlorate solutions. The compounds $UO_2(ClO_4)_2H_2R$ and $La(ClO_4)_2(H_2R)^+$ were formed in the solutions. These compounds have formation constants of $(3.53 \pm 0.36) \times 10^3$ and $(4.25 \pm 0.10) \times 10^1$ and molar coefficients of light attenuation of $(6.67 \pm 0.28) \times 10^4$ and $(6.52 \pm 0.09) \times 10^4$ at 650 nm, respectively. (tr-auth)

33679 NATURE OF PRECIPITATES FORMED ON DISSOLUTION OF METALLIC URANIUM IN OXYGEN-FREE ACIDS. Ermolaev, M. I. (Voronezh Technological Inst., USSR). Zh. Neorg. Khim.; 15: 745-8(Mar 1970). (In Russian).

The dissolution of metallic uranium in HCl and HI is accompanied by the formation of insoluble precipitates. This precipitate dissolves well in anhydrous pyrophosphoric acid and the dissolution is accompanied by the evolution of hydrogen. On heating in an atmosphere of hydrogen at constant pressure, the insoluble precipitate is decomposed to hydrogen and metallic uranium at 456 to 460°C, the same temperature at which uranium hydride decomposes. Thus, the dissolution of metallic uranium in oxygen-free acids is shown to be accompanied by hydridation. (tr-auth)

33680 REACTIONS OF TRIFLUOROMETHYL RADICALS WITH MONOSILANE AND MONOSILANE-d_4. Jakubowski, E.; Sandhu, H. S.; Gunning, H. E.; Strausz, O. P. (Univ. of Alberta, Edmonton). J. Chem. Phys.; 52: 4242-8(15 Apr 1970).

Arrhenius parameters for the reactions of trifluoromethyl radicals, produced by the photolysis of hexafluoroazomethane, with SiH_4 and SiD_4 were measured. It was found that CF_3 radicals are more reactive than CH_3, the difference in reactivity being due to lower activation energies, as the A factors are almost identical. A theoretical value of E_a obtained by the BEBO method using a simple three-mass-point model is compared with the experimental. The BEBO and LEPS methods were used to predict kinetic isotope effects with and without tunneling corrections for comparison with experimental results. (auth)

33681 LOW-FREQUENCY VIBRATIONS OF MOLECULAR CRYSTALS. VII. DMSO AND DMSO-d_6. Durig, J. R.; Player, C. M. Jr.; Bragin, J. (Univ. of South Carolina, Columbia). J. Chem. Phys.; 52: 4224-33(15 Apr 1970).

The far-infrared spectra of polycrystalline dimethyl sulfoxide and dimethyl sulfoxide-d_6 were measured from 600 to 33 cm^{-1} at various temperatures from −30 to −194°C. Raman spectra of both compounds in the liquid and solid states were recorded with 6328-Å helium–neon excitation. Assignments are made for internal and lattice vibrations in terms of the crystallographic unit cell $P2_1/c$ (C_{2h}^5) with four molecules per unit cell. A distinction between librational and translational lattice modes was made on the basis of the isotopic shift factors. The external fundamentals are readily explained in terms of a layer lattice unit cell with intralayer coupling between molecules being of greater significance than interlayer coupling. The interesting methyl torsion was observed in the infrared at 257 cm^{-1} in the "light" compound shifting to 189 cm^{-1} with deuterium substitution. The threefold barrier to internal rotation was calculated to have a value of 4.4 kcal/mole for the solid. This barrier is compared to that found in the vapor as well as those obtained for structurally similar phosphorous compounds. It appears that oxygen raises the barrier by about 1 kcal/mole. No evidence for short-range ordering could be found in the Raman spectrum of the liquid. (auth)

33682 VAPOR PRESSURES OF SOME DEUTERATED PROPYLENES. McDaniel, Robert L.; Van Hook, W. Alexander (Univ. of Tennessee, Knoxville). J. Chem. Phys.; 52: 4027-30(15 Apr 1970).

The deuterium vapor pressure isotope effect was measured for CH_2CDCH_3, CH_2DCHCH_2, CH_2CHCD_2, and CD_2CDCD_2 using mercury manometry. The samples were of high isotopic purity and were chemically purified using low temperature gas chromatography. Substitution at the ethylenic end of the molecule resulted in an inverse isotope effect of 0.5% per D near 240°K falling off to a normal effect of 1% per D near 150°K. At the higher temperatures the law of the mean was nearly obeyed but deviations, of course, occur around the crossover. The monodeuteromethyl compound shows an inverse effect of about 1% per D at 240°K and displays a very broad maximum around 1.3% per D near 160°K. The perdeutero compound also displays a broad maximum. Its effect is larger than that predicted from the approximate theory. (auth)

33683 RAMAN SPECTRAL STUDIES OF THE EFFECTS OF PERCHLORATE ION ON WATER STRUCTURE. Walrafen, G. E. (Bell Telephone Labs., Inc., Murray Hill, N. J.). J. Chem. Phys.; 52: 4176-98(15 Apr 1970).

Raman contours corresponding to the OD and OH stretching vibrations from HDO, as well as from H_2O and D_2O were obtained at 25°C from a series of ternary aqueous solutions containing HDO, ClO_4^- (Li^+, Na^+, K^+), and H_2O or D_2O. Addition of ClO_4^- to solutions containing HDO, and H_2O or D_2O produce a pronounced splitting of the OD and OH stretching contours from HDO, as well as from D_2O and H_2O. The splittings were directly observable in the Raman spectra. Two principal peaks or components, having frequencies nearly identical to components uncovered previously in the absence of ClO_4^-, resulted in the HDO case (or four major components in the D_2O and H_2O cases). The Raman intensities of the high-frequency OD or OH components from HDO (or of the corresponding high-frequency D_2O or H_2O components) increased relative to the low-frequency components with addition of ClO_4^-. The effects were evident even at 0.5M ClO_4^- and below. In addition, isosbestic frequencies were observed from the binary and ternary perchlorate solutions for bands of HDO, D_2O, and H_2O, and the values compared favorably with isosbestic frequencies obtained previously at a series of temperatures. Examination of the OD and OH stretching contours from HDO at high ClO_4^- concentration, at which the high-frequency components are nearly isolated, also indicates that the component shapes are Gaussian. The Raman data indicate that the ClO_4^- ion is a strong structure breaker, and that it does not hydrate appreciably, in agreement with the recent infrared absorbance results of Kecki et al. The data also provide clear evidence in contradiction to spectroscopic continuum models of water and aqueous solutions, but mixture models involving several major classes of interactions, e.g., hydrogen-bonded or non-hydrogen-bonded OD or OH groups, and OD or OH groups engaged in the hydration of cationic and anionic species, but excluding ClO_4^-, are in accord with the data. (auth)

33684 EVOLUTION OF THE STABILITY OF THE BIVALENT STATE OF THE 4f AND 5f SERIES ELEMENTS. David, F. (Paris Univ., Orsay, France). Rev. Chim. Miner.; 7: No. 1, 1-11(1970). (In French).

Through amalgamation under controlled potential of Ce and Bk on one hand, Sm and Eu on the other hand, as well as Ba, the amalgamation kinetics in citric medium of the 4f and 5f elements in the tervalent state may be interpreted by a process comprising their reduction to the bivalent state in an intermediate phase. An estimation of the M^{3+}/M^{2+} normal potential of most of these elements allows the evolution of the redox properties in both series to be compared; this evolution is not parallel. (France)

33685 VIBRATIONAL CONSTANTS OF THE GROUND STATES OF H_2^+, HD^+, AND D_2^+ FROM PHOTOELECTRON SPECTROSCOPIC MEASUREMENTS. Cornford, A. B.; Frost, D. C.; McDowell, C. A.; Ragle, J. L.; Stenhouse, I. A. (Univ. of British Columbia, Vancouver). Chem. Phys. Lett.; 5: 486-8(1 Jun 1970).

The 584 Å photoelectron spectra of H_2^+, HD^+, and D_2^+ allow the vibrational intervals in the $^2\Sigma_g^+$ states of these ions to be measured, and so the vibrational constants ω_e and $\omega_e x_e$ can be derived. These new experimental values are compared with previous theoretical calculations. (auth)

33686 EXTERNAL HEAVY ATOM EFFECT ON RADIATIVE AND RADIATIONLESS TRANSITIONS FROM THE BENZOPHENONE-SENSITIZED TRIPLET OF SOME PERDEUTERATED AND PERPROTONATED AROMATIC HYDROCARBONS. Webber, S. E. (Univ. of Texas, Austin). Chem. Phys. Lett.; 5: 466-70(1 Jun 1970).

The relative quantum yields of the sensitized phosphorescence of perdeuterated and perprotonated naphthalene, phenanthrene, and biphenyl were studied in solvents that contain heavy atoms. It was found that the quantum yields of the perdeuterated and perprotonated molecules are approximately equal in the presence of a heavy atom solvent. This result may be interpreted as implying that the radiationless rates for these isotopically substituted molecules become essentially equal if the spin-orbit coupling of the singlet and triplet manifolds is substantially increased. (auth)

33687 DEUTERIUM ISOTOPE EFFECTS IN ENZYMATIC TRANSAMINATION. Fang, Sen-maw. Urbana, Ill.; Univ. of Illinois (1969). 110p.

Thesis.

The ionic fraction obtained from the hydrolysate of residual cell walls of Scenedesmus obliquus grown in a medium containing 99.6% D_2O was subjected to ion-exchange chromatography for fractionation of fully deuteriated L-glutamic acid and L-aspartic acid. The amino acids were characterized by elemental analysis, paper chromatography, ir, and NMR. The extent of deuteriation of these compounds was established by NMR spectral analyses. Two partially deuteriated L-glutamic acids; i.e., L-glutamic acids-2-d_1 and L-glutamic acid-3,3,4,4-d_4, were synthesized from L-glutamic acid and L-deuterio-glutamic acid (L-glutamic acid-2,3,3-4,4-d_5), respectively. The general synthesis consisted of three steps: 1) acetylation of the amino acid, 2) racemization of N-acetyl-amino acid in a medium containing either deuterium oxide or ordinary water, 3) selective hydrolysis of the L-enantiomorph by means of acylase. The kinetic study of the enzymatic transamination was conducted using four L-glutamic acids (L-glutamic acid and three of its deuteriated analogs) as the substrates. The rate of transamination was followed by photometric measurements at 280 mμ. Kinetic derivation of maximum velocity, based on the binary mechanism of the enzymatic transamination, was performed on each of the four L-glutamic acid analogs. The deuterium isotope effect was estimated through maximum velocity analysis. The compound with deuterium in the α-position showed an isotope effect of 1.85. A similar isotope effect was observed for the compound with deuterium at the α-, β-, and γ-carbons. The data indicate that the bond to the α-carbon and not to the β-carbon is ruptured during the reaction. It is conclusively demonstrated, therefore, that α-elimination mechanism is the one involved in the enzymatic transamination. L-Glutamic acid-3,3,4,4-d_4, the compound with no deuterium atom at the α-position, showed an isotope effect of 1.26. The effect can be explained in terms of secondary isotope effect exerted by the β-deuterium atoms through inhibition of the elimination of the α-hydrogen during the transamination. Deuterium isotope effect of fully deuteriated L-aspartic acid (L-aspartic acid-2,3,3-d_5) on the enzymatic transamination was also studied. (Diss. Abstr. Int., B)

33688 TRIPLET LIFETIME OF DIPHENYLPOLYENES AND DEUTERATED STILBENES IN FROZEN SOLUTION AT 77°K. Heinrich, G.; Holzer, G.; Blume, H.; Schulte-Frohlinde, D. (Kernforschungszentrum, Karlsruhe, Ger.). Z. Naturforsch.; 25b: 496-9(May 1970). (In German).

The lowest triplet states of diphenylpolyenes and of deuterated stilbenes were observed by means of photoflash absorption spectroscopy. The diphenylpolyenes do not show phosphorescence. The triplet lifetime is strongly dependent on triplet energy. This is consistent with the known influence of Franck-Condon factors. The triplet lifetime of partially deuterated stilbenes depends on the number and the position of the deuterium atoms. The effect of olefinic monodeuteration on the nonradiative process is approximately 16 times larger than that of deuteration at an aromatic position. The observations can be explained in terms of isotope effects on vibronic spin-orbit coupling. (auth)

33689 CRYSTAL STRUCTURES OF TETRAKIS-(TROPOLONATO)-N,N'-DIMETHYLFORMAMIDE-THORIUM(IV) AND AMMONIUM TETRAKIS-(TROPOLONATO)HOLMATE(III). Day, Victor Warren. Ithaca, N. Y.; Cornell Univ. (1969). 102p.

Thesis.

Molecular configurations and crystal structures, as determined by three-dimensional x-ray methods, are reported for single crystals of the N,N'-dimethylformamide-tetrakis(tropolonato)thorium-(IV) molecule, (DMF)ThT_4, and the ammonium salt of the tetrakis-(tropolonato)holmate(III) anion, HoT_4^-. (The tropolonato ion, $C_7H_5O_2^-$, is written as T^- and the bidentate tropolonato ligand as T in the formulas for complexed species.) Triclinic crystals of (DMF)ThT_4 (space group, $P\bar{1}$) containing two formula weights per unit cell have a = 15.222 ± 0.009, b = 10.922 ± 0.006, c = 9.452 ± 0.005, cos α = −0.3972 ± 0.0001 (α = 113.40°), cos β = −0.1114 ± 0.0003 (β = 96.40°), and cos γ = 0.0430 ± 0.0004 (γ = 87.53°), with measured and calculated densities of 1.826 and 1.830 g/cc, respectively. Monoclinic crystals of NH_4HoT_4 (space group, C2/c) containing sixteen formula weights per unit cell have a = 22.498 ± 0.010, b = 18.176 ± 0.008, c = 29.073 ± 0.013, and cos β = −0.4130 ± 0.0004 (β = 114.40°), with measured and calculated densities of 1.635 and 1.638 g/cc, respectively. Both crystalline species are piezoelectrically inactive. Diffracted intensities for the thorium complex were recorded with Zr-filtered Mo Kα radiation by the θ-2θ scanning technique on a Picker card-controlled four-circle diffractometer. From a total of 7476 independent reflections (representing ~1.3 Cu Kα spheres) which were measured, 6792 had net intensities which were objectively above background. Diffracted intensities for the holmium complex were photographically recorded with Zr-filtered Mo Kα radiation using a combination of multiple-film Weissenberg and precession techniques. Following reduction of both sets of intensity data to relative amplitudes, $|E_o|$, Patterson, Fourier, and difference syntheses were employed in the heavy atom technique to determine the respective crystalline arrangements. Block-diagonal least-squares refinements that utilized individual anisotropic thermal parameters for all atoms except hydrogen led to the final structural parameters for both compounds. Conventional R values of 0.047 for (DMF)ThT_4 and 0.075 for NH_4HoT_4 were obtained. In the nine-coordination group of the (DMF)ThT_4 molecule, eight tropolonato-oxygen atoms and the oxygen atom of the neutral DMF ligand are bonded to the thorium(IV) atom in fair approximation to C_{4v} monocapped square antiprismatic geometry with a tropolonato-oxygen atom in the "capping" position. A quasi-mirror plane, containing the thorium atom, DMF oxygen atom, and tropolonato ligand d, is observed for the coordination group and tropolonato ligands. The average tropolonato Th-O bond length is 2.450 Å while the DMF Th-O bond length is 2.519 Å. In both crystallographically independent eight-coordinate HoT_4^- anions contained in the asymmetric unit of NH_4HoT_4, eight tropolonato-oxygen atoms are bonded to the holmium (III) atom in fair approximation to idealized D_{2d} dodecahedral geometry. All tropolonato ligands span dodecahedral m edges, thus giving mmmm stereoisomers. The eight independent Ho-O bonds present in each complex average to 2.35 Å in anion I and 2.36 Å in anion II. No systematic differences are observed between dodecahedral A- and B- type metal-oxygen bond lengths. (Diss. Abstr. Int., B)

33690 CHEMICAL KINETICS AND KINETIC ISOTOPE EFFECT IN THE REACTIONS OF CF_3 RADICALS WITH H_2S AND D_2S. Kale, Jayavant Damodar. Washington, D. C.; Catholic Univ. of America (1969). 55p.

Thesis.

The gas phase reactions of trifluoromethyl (CF_3) radicals with H_2S and D_2S were studied over the temperature range of 55 to 160°. The CF_3 radicals were generated by the photolysis of hexafluoroacetone (HFA) at wavelengths λ = 3100 Å. The reaction conditions were such that any chemical quenching of electronically excited HFA by H_2S or D_2S was minimized. The rate constants for the reactions $CF_3 + H_2S \xrightarrow{k_H} CF\,H + SH$ and $CF_3 + D_2S \xrightarrow{k_D} CF_3D + SD$ were found to be $k_H = 10^{11.20\pm0.10} \exp[(-1200 \pm 100)/RT]$ cc mol^{-1} sec^{-1} and $k_D = 10^{11.15\pm0.08} \exp[(-2100 \pm 150)/RT]$ cc mol^{-1} sec^{-1}. These values were calculated using the reported value for recombination reaction of CF_3 radicals. The experimental kinetic isotope effect was evaluated from the rate constants ratio, k_H/k_D, given by $k_H/k_D = 1.1 \exp(900/RT)$. The theoretical kinetic isotope effects predicted by the transition state theory were compared with the observed kinetic isotope effects. Two different approaches were used to calculate the properties of the activated complex. The potential energy surface was constructed using the semi-empirical equation of London-Eyring-Polanyi-Sato and the properties of the activated complex were obtained at the saddle point on the surface. From these calculated force constant and bond distances in the activated complex the theoretical isotope effects were predicted for different models of the activated complex. A similar procedure was applied for the Bond-Energy-Bond-Order method of obtaining the activated complex. In general, the rather poor agreement between the theory and experiments can be explained in terms of the unusual potential energy surface involved in these reactions. (Diss. Abstr. Int., B)

33691 PART I. THEORETICAL CALCULATIONS OF ISOTOPE EFFECTS IN ELIMINATION REACTIONS. PART II. EXPERIMENTAL AND THEORETICAL STUDIES OF SULFUR ISOTOPE EFFECTS IN DISPLACEMENT REACTIONS OF TRIMETHYLSULFONIUM ION. Katz, Arthur Marvin. Rochester, N. Y.; Univ. of Rochester (1969). 238p.

Thesis.

Deuterium and sulfur isotope effects were calculated for E2 reactions using the Wolfsberg-Schachtschneider FG matrix program. Initially, "simplified" models of 4, 5, and 6 atoms were examined models which did not prove satisfactory. However, they did demonstrate the importance of the various stretching and bending vibrations in determining the magnitude of the isotope effects. A more realistic model was then employed. The model reaction of ethyldimethylsulfonium ion with hydroxide was chosen. The dependence of the isotope effects on transition state force constants was examined. Off diagonal elements in the F matrix were employed to obtain zero and imaginary reaction coordinate frequencies. In the models the deuterium isotope effect reached its maximum at approximately half-transferred. For the ethyldimethylsulfonium model large variations of the strength of the carbon-sulfur bond produced minimal variations of the deuterium isotope effect. Similarly, the strength of the carbon-sulfur bond

in the transition state is the primary determinant of the sulfur isotope effect. Off diagonal elements were employed to couple the proton transfer to other atomic motions, thus producing a simulated E2 transition state motion. Calculations of the sulfur isotope effect indicate that the isotope effect does not become significantly large until the carbon-sulfur stretching force constant had decreased to less than half its original value, and then it increases quite sharply. The sulfur isotope effects for the displacement reaction of methyl sulfide from trimethylsulfonium bromide with various nucleophiles, phenoxide, ethoxide, thiophenoxide, and bromide were experimentally determined. The sulfur isotope effects $((k_{32}/k_{34}-1) \times 100)$ determined for bromide, thiophenoxide, ethoxide, and phenoxide were 1.36%, 1.20%, 0.96%, and 0.96% respectively. The magnitude of these isotope effects indicated that considerable carbon-sulfur bond breaking occurred for the reaction with all nucleophiles. Extensive theoretical calculations of α-deuterium and sulfur isotope effects were undertaken for model reactions of trimethylsulfonium-cation with ethoxide, phenoxide, thiophenoxide, and bromide. In the case of the bromide, the bromine isotope effect was also calculated. A model for an S_Ni reaction was examined. The results of the sulfur isotope effect calculations for the various models indicated that the isotope effect is a good measure of the extent of carbon-sulfur bond breaking. Significantly, the sulfur isotope effect shows the same variations with bond order in these calculations as in previous calculations of sulfur isotope effects for model elimination reactions. Further, the α-deuterium isotope effect for model calculations with thiophenoxide as nucleophile showed larger isotope effects than calculations with ethoxide and phenoxide as the nucleophiles. Calculated α-deuterium isotope effects invert the order of the experimentally determined isotope effects, i.e., the ethoxide and phenoxide reactions have larger α-deuterium isotope effects than the thiophenoxide reaction. From the available experimental and calculated isotope effects it can be concluded that there existed significant differences between the transition states of the ethoxide and phenoxide reactions and the transition state for the thiophenoxide reaction. In view of all the data, it was concluded that the transition states for the displacement reactions were unsymmetrical with the breaking bond of lower bond order than the forming bond. In the case of the thiophenoxide reaction the bond order of the forming bond is greater than the bond order of the forming bond for the ethoxide or phenoxide reactions. Apparently, the ethoxide and phenoxide transition states were "looser," i.e., of lower total bond order than the transition state for the reaction with thiophenoxide. (Diss. Abstr. Int., B)

33692 AN AC POLAROGRAPHIC STUDY OF SOME ELECTROCHEMICAL REACTION MECHANISMS. Evilia, Ronald Frank. Bethlehem, Pa.; Lehigh Univ. (1969). 150p. Thesis.

The construction of an ac-dc polarograph is described. The dc section of the polarograph is of standard design. The ac section makes use of a commercially available lockin amplifier. The instrument is tested with the model system $Cd^{2+} + 2e \rightleftharpoons Cd(Hg)$ and is found to be equal to or better than previously described ac polarographs. The mechanism of the electrochemical reduction of the monohalopyridines is studied with the instrument. The dc polarographic half-wave potential is found to vary with pH (over a range of pH's determined by the isomer being reduced). The half-wave potential is determined by the isomer being reduced and the pH of the solution. At high pH it is observed that all isomeric iodopyridines reduce with the same reduction half-wave potential. The polarographically measured pKa's values of the various pyridinium species are in poor agreement with the literature values. Two mechanisms for the halopyridine reductions are proposed: an acidic mechanism and an alkaline mechanism. The acidic mechanism is a two step process which explains the pKa values on the basis of the stability of the intermediate. The alkaline mechanism is an EC mechanism in which the carbon-halogen bond is polarized prior to electron transfer. The catalytic oxidation of uranium (III) by nitrate ion was studied by ac polarography. The reaction mechanism was not a simple collisional process. The observed rate law is: $\text{Rate} = k_1(NO_3^-)^x - k_2(UO_2^{2+})^y$. A mechanism involving an "electron bridge" between the electrode and nitrate ions is proposed from the rate law. The mechanism of reduction of UO_2^+ to U^{3+} is found to be: $UO_2^+ + e^- \rightarrow UO_2$, $UO_2 + 4H^+ \rightarrow U^{4+} + H_2O$, $U^{4+} + e^- \rightleftharpoons U^{3+}$. The reduction of uranium (V) to uranium (III) in the presence of nitrate ion is found to give ac-polarographic data inconsistent with any mechanism studied theoretically. (Diss. Abstr. Int., B)

33693 PART I. CYCLOADDITIONS OF DIPHENYLKETENE TO OLEFINS. PART II. THE STRUCTURES OF SOME ADDUCTS FROM CARBON DISULFIDE AND ALPHA-DIAZOKETONES. Kapecki, Jon Alfred. Urbana, Ill.; Univ. of Illinois (1969). 276p. Thesis.

Diphenylketene reacts with p-substituted styrenes to give 2, 2-diphenyl-3-arylcyclobutanones. The ρ-value for the process (bromobenzene, 119.96°) is −0.7. A slight decrease in reaction rate is observed in solvents of increasing dielectric constant. The process occurs stereospecifically cis with respect to the olefin as determined by reaction with cis-β-deuteriostyrene. Secondary deuterium isotope effects were determined in competition reactions of diphenylketene with styrene and α-deuteriostyrene or β, β-dideuteriostyrene. At 65°C the isotope effects k_H/k_D, corrected to d_1, were 0.91 at β-carbon and 1.23 at the α-carbon. These results suggest that reaction proceeds by an essentially concerted (2 + 2 + 2) sss process in accord with Hoffmann-Woodward rules of conservation of orbital symmetry. The addition of diphenylketene to p-substituted 1,1-diarylethylenes proceeds to give an adduct composed of two moles of the ketene and one mole of the olefin. The reaction is first order with respect to each component and exhibits a ρ-value of −0.7 (for 2 σ). The reactions of diphenylketene with other olefins is described, and the area of (2 + 2) cycloadditions is briefly reviewed. The cycloadduct from 3-diazobutanone and carbon disulfide was shown by single crystal x-ray diffractometry to be a 2-methylene-1, 3-dithiacyclobutane. However, ^{19}F-labeling demonstrated that the principal adduct derived from p-fluorobenzyl-p-fluorobenzoyl diazomethane is a 2-methylene-1,3-dithia-4-cyclopentanone. By analogy and comparisons of the spectral data, the adduct from benzylbenzoyldiazomethane possesses a similar structure. The adduct from 3-diazobutanone and carbon disulfide contains a significantly short (2.64 Å) sulfur-oxygen intramolecular distance. The possibility of S−O bonding in this and similar systems was explored by means of extended Hückel calculations. Covalent S−O interactions in such systems were found to be negligible. The effects of steric and electrostatic interactions in these systems are considered. (Diss. Abstr. Int., B)

33694 HOMOGENEOUS EXCHANGE REACTION: $CD_4 + CH_4 \rightarrow CD_3H + CH_3D$. SINGLE PULSE SHOCK TUBE STUDIES. Burcat, Alexander; Lifshitz, Assa (Hebrew Univ., Jerusalem). J. Chem. Phys.; 52: 3613-18(1 Apr 1970).

The homogeneous exchange reaction between CH_4 and CD_4 was investigated using the single pulse shock tube technique. The temperature range covered was 1340 to 1745°K, and concentrations up to 8% total methane in argon were used. The over-all rate of exchange was proportional to the 3/2 power of the methane concentration and independent of the argon density. The rate of exchange in mixtures containing 4% CH_4 + 1% CD_4 and 4% CD_4 + 1% CH_4 was found to be the same, indicating a negligible isotope effect at the temperature range covered in this study. For mixtures in which $[CH_4] = [CD_4]$ the rate of exchange is given by $d[CD_3H]/dt = k_r [CH_4]^{0.75}[CD_4]^{0.75}$, where $k_r = 4.3 \times 10^{14} \exp[-(70 \pm 2) \times 10^3/RT]cc^{0.5}\,mole^{-0.5} \cdot sec^{-1}$. It was shown that the exchange proceeds via a chain reaction mechanism carried by CH_3 and CD_3 free radicals. The evaluated rate constants for the chain, $CH_3 + CD_4 \xrightarrow{k_3} CD_3 + CH_3D$, $CD_3 + CH_4 \xrightarrow{k_4} CH_3 + CD_3H$, are by a factor of 10 higher than the ones extrapolated from the low temperature studies on the basis of an Arrhenius plot. (auth)

33695 PROTON-TRANSFER REACTIONS IN THE SIMPLE ALKANES: METHANE, ETHANE, PROPANE, BUTANE, PENTANE, AND HEXANE. Futrell, J. H.; Abramson, F. P.; Bhattacharya, A. K.; Tiernan, T. O. (Aerospace Research Labs., Wright-Patterson AFB, Ohio). J. Chem. Phys.; 52: 3655-64 (1 Apr 1970).

Proton-transfer reactions from CHO^+ and CDO^+ to the simple alkanes, methane through hexane, were investigated in a tandem mass spectrometer. Acetaldehyde is shown to be the molecular source yielding CHO^+ reactant with the lowest internal excitation energy. The translational energy dependence observed for the reactions, $CHO^+ + CH_4 \rightarrow CX_5^+ + CO$ and $CX_5^+ \rightarrow CX_3^+ + X_2$ (X = H or D), suggests that the interaction is better represented over the energy range considered as proton stripping rather than as proceeding through an intermediate $[CXO^+ - CX_4]^*$ complex. In addition, there is no evidence from isotope effects for a transition in mechanism. A highly simplified model treating the protonated methane species as a collection of closely coupled harmonic oscillators permits application of the classic rate expression for unimolecular decomposition to the dissociation yielding CH_3^+, and this relation provides a reasonable semiempirical fit to the experimental data. The reaction of CHO^+ with ethane at quasithermal energy yields $C_2H_5^+$ in relatively large abundance. $C_2H_5^+$ is the major product, but isotopic experiments indicate that the latter is not formed by a direct hydride ion abstraction but instead results from dissociation of the protonated ethane ion. Isotopic evidence also indicates that 1,1 elimination of hydrogen from protonated ethane is more probable by a factor of 1.5 than 1,2 elimination. Further, there is a slight preference for eliminating the added

proton even at the lowest kinetic energy, a tendency which is more pronounced at higher energies. The extreme sensitivity to slight changes in internal energy, which is demonstrated in the $C_2H_7^+$ decomposition, is shown to account for the failure to detect $C_2H_7^+$ as an intermediate in the CH_3^+/CH_4 reaction. For alkanes larger than ethane, no protonated molecular ion could be observed, although the reactions of these hydrocarbons with CHO^+ can also be reasonably interpreted as proton transfer followed by decomposition. For the higher hydrocarbons a greater number of decomposition paths are evident, and there is an increased tendency to eliminate the added proton at low kinetic energies. Proton addition to the hexanes apparently occurs by a fairly random attack of the protonating agent on the carbon skeleton. The relative intensities of decomposition products in the latter case suggest that the protonated hexanes undergo rearrangement prior to dissociation. (auth)

33696 MICROWAVE SPECTRUM OF BENZALDEHYDE. Kakar, Ramesh (Univ. of Wyoming, Laramie); Rinehart, Edgar A.; Quade, C. R.; Kojima, Takeshi. J. Chem. Phys.; 52: 3803-13(1 Apr 1970).

The microwave absorption spectrum of C_6H_5CHO was investigated in the region 17.5 to 40.0 GHz and that for C_6H_5CDO in the region 26.5 to 40.0 GHz. Rotational transitions in the ground and first three excited torsional states in both molecular species were identified. There is evidence for interaction of the second torsional state of C_6H_5CHO with another mode of vibration of the molecule. Accurate relative intensity measurements give the first torsional frequency of 113.8 ± 5.0 cm^{-1} for C_6H_5CHO and of 108.4 ± 4.25 cm^{-1} for C_6H_5CDO. The barriers to internal rotation of the aldehyde group calculated from these frequencies are 4.90 ± 0.43 and 5.28 ± 0.42 kcal/mole for C_6H_5CHO and C_6H_5CDO, respectively. The discrepancy between the observed and calculated values of inertial coefficients suggests the importance of vibration–rotation interaction in the theory of internal rotors with twofold potential barriers. (auth)

33697 RAMAN SCATTERING IN CRYSTALLINE POLYETHYLENE. Boerio, F. J.; Koenig, J. L. (Case Western Reserve Univ., Cleveland). J. Chem. Phys.; 52: 3425-31(1 Apr 1970).

The Raman scattering in crystalline polyethylene, deuterated polyethylene, and n-paraffins was investigated as a function of temperature. Crystal-field splitting of the A_{1G} methylene bending mode observed at room temperature increased at –160°C in both polyethylene and deuterated polyethylene. No splitting of the B_{2G} skeletal stretching mode and the B_{1G} methylene twisting modes in polyethylene was observed at room temperature, but the two components of the space group fundamental were resolved at –160°C. Similarly, splitting of the B_{3G} methylene wagging mode in deuterated polyethylene was observed at –160°C but not at room temperature. The observed crystal-field splittings are discussed in terms of splittings calculated from repulsive forces between hydrogen atoms on neighboring chains in the polyethylene crystal. (auth)

33698 CRYSTAL STRUCTURE OF UVO_5. Chevalier, Raymond; Gasperin, Madeleine (Paris Univ.). Bull. Soc. Fr. Miner. Crist.; 93: 18-22(Jan-Feb 1970). (In French).

The crystal structure of UVO_5 was determined by single crystal diffraction methods. This compound crystallizes in the orthorhombic system. The unit cell dimensions are: a = 12.31, b = 7.19, c = 4.12 Å. The pentagonal bipyramids (UO_7) are linked together in the b-direction by sharing basal edges to form zigzag chains and the tetragonal pyramids (VO_5) share basal apices also in the b-direction. The relationship between the UVO_5 structure and structures containing pentavalent vanadium are briefly discussed. (France)

33699 KINETIC DEUTERIUM ISOTOPE EFFECT IN THE REACTION OF METHYL IODIDE WITH THIOSULFATE ION IN AQUEOUS SOLUTION. Willi, A. V.; Won, C. M. (Columbia Univ., New York). Can. J. Chem.; 48: 1452-5(1 May 1970).

The kinetic deuterium isotope effect in the reaction of methyl iodide with thiosulfate ion in aqueous solution was determined as follows: k_H/k_D (per 3D) = 0.966 (+0.02°), 0.968 (+10.00°), 0.970 (+19.98°). Kinetic experiments were carried out in reaction vessels with no gas phase. The experimental data are compared with results of model calculations of isotope effects from force constants. Excellent agreement between experimental and calculated isotope effects may be obtained with the following values of the transition state bending force constants: f_{HCl} = 0.295 mdyn Å, f_{HCS} = 0.300 to 0.320 mdyn Å. These values are equal to 50 to 65% of the corresponding bending force constants in stable molecules. (auth) (Canada)

33700 RELEASE OF RARE GAS FISSION PRODUCTS FROM POLYMER FILMS. Scobie, J.; Scott, R. D.; Wellum, R. (Scottish Research Reactor Centre, East Kilbride, Scotland). Radiochim. Acta; 13: 119-20(1970).

Data were obtained from 1.6-cm-dia Mylar foils placed 2 mm above a ^{235}U deposit 1 cm in dia and of 2 mg total weight, in a thermal neutron flux of about 10^9 n/cm² sec. After irradiation for a period of 10^4 sec, the gross fission products γ spectrum from each foil was examined. Similar measurements were made with aluminum catcher foils. Examination of the γ spectra gave no evidence for the release of fission products other than rare gases, with the possible exception of iodine at a very low rate. The loss of a given rare gas fission product from the Mylar foils can be expressed as the ratio of the appropriate γ peak intensity in the Mylar foil to that in the aluminum foil. (M.C.G.)

33701 SPECTROSCOPIC STUDY OF MOLECULAR COMPLEXES BETWEEN THE FLUORIDES OF HYDROGEN AND DEUTERIUM AND VARIOUS PROTON ACCEPTORS IN THE GAS PHASE. Couzi, Michel; Le Calve, Jacques; Pham Van Huong; Lascombe, Jean (CNRS, Bordeaux). J. Mol. Struct.; 5: 363-73 (May 1970). (In French).

The infrared spectra of gaseous mixtures of hydrogen fluoride and various organic bases B were recorded from 5000 to 200 cm^{-1} at different partial pressures. Evidence is shown for the formation of bimolecular complexes, F–H ... B, and multimolecular complexes, ... F–H ... F–H ... B, in the gas state. A complete assignment of the spectrum is proposed, based in particular on a comparison of the spectra of hydrogen or deuterium fluoride and hydrogenated or deuterated organic base mixtures. (auth)

33702 GREEN'S FUNCTION ANALYSIS OF SOME X_2Y_2 LINEAR MOLECULES. Ramaswamy, K.; Srinivasan, K. (Annamalai Univ., Annamalainagar, India). J. Mol. Struct.; 5: 337-44(May 1970).

The Green's function and partitioning techniques were applied to the case of some linear symmetrical tetratomic molecules in order to obtain isotopic rules for symmetrical and asymmetrical substitutions. The new isotopic rule obtained for the asymmetrical substitution is very simple in form and the agreement between the calculated and observed fundamentals is very good. The force constants, mean amplitudes of vibration, rotational distortion constants and Coriolis coupling constants have been computed and compared with other calculated and observed values, whichever is available. The agreement is quite good in all cases. (auth)

Radiation and Nuclear Chemistry

Refer also to abstracts 33657, 33757, 33943, 34472, and 35574.

33703 (AD–702924) RADIATION-INDUCED NITRATION OF BENZENE WITH DINITROGEN TETROXIDE. Smetana, Andrew F.; Castorina, Thomas C. (Picatinny Arsenal, Dover, N. J.). Mar 1970. 36p. (PA-TR–3915). CFSTI.

The gamma-induced nitration of benzene with dinitrogen tetroxide (N_2O_4) in the liquid phase at 20°C yielded nitrobenzene (NB) as the major product and the isomerides of dinitrobenzene (DNB) as the minor products of radiolysis. The yield G (NB) increased with increasing concentration of N_2O_4 from 0.14 for 6 mole % N_2O_4 to 1.18 for 95 mole % N_2O_4 in benzene. The ratio of o- to p-DNB is the inverse of that obtained from conventional mixed acid nitration and is considered typical of radiolysis. The nitro-substitution product formations are shown to be from primary processes of radiolysis and are proposed as being derived from an intermediate specie involving an $NO_2 \cdot C_6H_5H(+)$ pi-donor complex. The NO_2 in equilibrium with the N_2O_4 in the liquid phase is regarded as the nitrating agent in the form of a radical as well as a nitronium ion ($NO_2(+)$). Both water and nitrous acid as secondary products of radiolysis are suggested as anticatalysts inhibiting the degree of the radioinduced nitration. (auth) (USGRDR)

33704 (HMI-B–91) ANNUAL REPORT, 1969. (Hahn-Meitner-Institut fuer Kernforschung, Berlin (West Germany)). May 1970. 305p. (In German). Dep. CFSTI (U. S. Sales Only).

Research progress is reported on: nuclear chemistry, mathematics, nuclear physics, radiation chemistry, electronics, reactor development, and radiation physics. (M.C.G.)

33705 (NYO–2807–82) SUMMARY OF PROGRESS [ON RADIATION CHEMISTRY], MAY 16, 1969–MAY 15, 1970. (Princeton Univ., N. J. Dept. of Chemical Engineering). Contract AT(30-1)-2807. 13p. Dep. CFSTI.

Topics covered include: energy transfer in gases, energy deposition by fission fragments for chemonuclear applications, Moessbauer studies of phase transitions, Moessbauer studies of lattice dynamics, Moessbauer studies of bonding in ferrous com-

pounds, radiation chemistry of N_2 and of H_2–D_2, semiconductor particle detector studies of fission fragment energy loss, radiation chemistry and damage induced by fast neutrons, Moessbauer studies of krypton compounds, anomalous charge states in Moessbauer spectra, lattice and molecular dynamics from Moessbauer data, anharmonicity and phase transitions, Moessbauer instrumentation, and quantitative analysis in corrosion studies by the Moessbauer effect. (M.C.G.)

33706 (RRL–2310–304) ESR-INVESTIGATIONS DURING THE RADIOLYSIS OF AQUEOUS SOLUTIONS. Eiben, Klaus; Fessenden, Richard W. (Mellon Inst., Pittsburgh, Pa. Radiation Research Labs.). 8 Jun 1970. Contract AT(30-1)-2310. 3p. (CONF-700610–1). Dep. CFSTI.

From 4th International Congress of Radiation Research, Evian, France.

A new in situ ESR-technique was developed, which allows the direct detection of transient radicals during the radiolysis of aqueous solutions. An electron beam of a 2.8-MeV Van de Graaff was focused on the solution in the quartz cell, generating the transient radicals that were recorded with a Varian ESR-spectrometer. For reactions of the hydrated electrons with several dissolved organic compounds it was revealed that radical intermediates are produced by either electron addition or dissociative electron attachment. (auth)

33707 (UCRL–19420, pp 46–55) FREE RADICALS IN PYRIMIDINES: ESR OF IRRADIATED SINGLE CRYSTALS OF OROTIC ACID. Horan, Paul Karl; Snipes, Wallace C. (California Univ., Berkeley. Lawrence Radiation Lab.).

Hydrogen abstraction from $N_{(1)}$ occurs when single crystals of orotic acid are exposed to ionizing radiation at room temperature. The stable free radical has unpaired spin density on both $N_{(1)}$ and $C_{(5)}$ of the pyrimidine ring. Hyperfine coupling to the nitrogen nucleus shows axial symmetry, with $A_{\parallel}^{N} = 15.0$ gauss and $A_{\perp}^{N} = 0$. The hydrogen bonded to $C_{(5)}$ has principal hyperfine values, in gauss, of $A_x^H = 7.3$, $A_y^H = 22.2$, and $A_z^H = 15.1$. From the hyperfine couplings, the spin densities calculated for $N_{(1)}$ and $C_{(5)}$ respectively are 0.29 and 0.65. Principal values of the g-tensor are $g_x = 2.0059$, $g_y = 2.0052$, and $g_w = 2.0023$. The ESR analysis can be used to predict the molecular orientation in orotic acid crystals. (auth)

33708 (UCRL–19420, pp 56–63) IRRADIATION OF DIHYDROTHYMINE IN FROZEN SULFURIC ACID SOLUTIONS. Henricksen, Thormod; Snipes, Wallace C. (California Univ., Berkeley. Lawrence Radiation Lab.).

Frozen solutions of dihydrothymine in H_2SO_4 irradiated at 77°K, contain large amounts of thymine after melting. Concentration studies show that the thymine must be produced mainly by indirect mechanisms. Low-temperature uv absorption measurements reveal that thymine is not present after irradiation at 77°K, but is formed on warming of the samples to about 160 to 200°K. ESR experiments suggest that the 5-thymyl radical is an intermediate in the production of thymine. At 77°K the irradiated samples contain only H atoms and some other unidentified H_2SO_4 radicals. The 5-thymyl radicals are formed upon warming to temperatures above 105°K, and they disappear in the temperature range at which thymine is formed. (auth)

33709 INCREASING PERMEABILITY OF POLYMER MEMBRANES BY IRRADIATION IN THE FULLY SWOLLEN STATE. Siegal, R. D.; Coughlin, R. W. (Lehigh Univ., Bethlehem, Pa.). Nature (London); 226: 938–40(6 Jun 1970).

The permeability of polyolefin film may be rendered selective towards a particular solvent by annealing the film below its dissolution temperature in the solvent, but such enhanced permeabilities are not permanent. In the studies described, it was demonstrated that, if solvent annealing of a polyethene film is followed by ^{60}Co γ-irradiation, whilst the film is still in contact with the annealing solvent, permeability is greatly increased and is much more permanent. All annealing of films and permeation measurement were carried out at 30°C, and the increase in temperature resulting from irradiation was not large enough to account for the observed permeability increase. The dose rate employed was 0.85×10^6 R/hr. Results are tabulated and shown in graphical form for a number of solvents. No loss of enhancement was observed over 500 hr, and even greater enhancement would be expected by combined solvent annealing and irradiation at higher temperatures. Explanations are advanced for the observed effects. Irradiation of swollen membranes also appears to enhance their capacity to discriminate between molecules. Potential applications are in dialysis in ion exchange, reverse osmosis, and other separation processes. (UK)

33710 SPECIFIC HEAT OF SOME GLASSY MIXTURES RADIOPOLYMERIZING AT LOW TEMPERATURE. Dworkin, Ary (Paris Univ., Orsay, France). J. Chim. Phys.; 67: 329–34(Feb 1970). (In French).

The specific heat of vinyl monomer–solvent mixtures, able to polymerize in the glassy state, was studied between 77 and 270°K and their glass transition temperatures determined. In the cases of methyl methacrylate or vinyl chloride plus paraffin oil, it was possible to observe exo or endothermic processes due respectively to recrystallization or fusion of the solute and linked to the demixtion of the mixtures during their cooling. The problems of crystallization in these mixtures were theoretically studied. The conclusions are in good agreement with experience. (France)

33711 RADIOLYSIS OF AQUEOUS SOLUTIONS BY IONIZING RADIATIONS OF HIGH LET. II. RADIOREDUCTION OF O_2 AND V^V INDUCED BY THE NUCLEAR REACTION $^{10}B(n,\alpha)^7Li$. Sigli, Paul (CEA, Fontenay-aux-Roses, France); Ferradini, Christiane; Pucheault, Jacques. J. Chim. Phys.; 67: 412–17(Feb 1970). (In French).

Recoil particles from the nuclear reaction $^{10}B(n,\alpha)^7Li$ give rise to the formation of hydrogen peroxide with a yield of 1.12 mol/100 eV in aerated boric acid solutions (0.8N H_2SO_4). Under the same conditions, V(V) is reduced with a yield increasing with concentration from 0.51 to about 1.05 mol/100 eV. From comparison of these yields with the results concerning the other systems, it was found for the intra-track reactions $H + H_2O_2 \rightarrow OH + H_2O$ and $H + OH \rightarrow H_2O$ $G_c = 0.17$ and $G_d = 0.27$, respectively. It was also concluded that dissolved oxygen from air is not a sufficiently good scavenger of H atoms to inhibit these reactions. (France)

33712 ELECTRON CAPTURING BY NITROUS OXIDE IN γ-IRRADIATED POLYPROPYLENE. Pinkerton, D. M. (Defence Standards Labs., Alexandria, Australia). Aust. J. Chem.; 23: 1039–42(May 1970).

Evidence is presented for scavengeable electrons in irradiated polypropylene. The presence of N_2O in isotactic propylene reduces the molecular H_2 yield compared with that of a vacuum irradiation, and the N_2 yield is increased to an extent indicating that N_2O scavenges electrons preferentially to H_2. A similar process for atactic propylene appeared negligible. (Australia)

33713 IDENTIFICATION OF HIGH ENERGY LINES IN THE K-LL AUGER SPECTRUM OF N_2. Carlson, Thomas A.; Moddeman, W. E.; Pullen, B. P.; Krause, Manfred O. (Oak Ridge National Lab., Tenn.). Chem. Phys. Lett.; 5: 390–2(15 May 1970).

The K–LL spectrum in nitrogen was measured with a high-resolution electron spectrometer using 3-keV electrons and AlK_α X rays to produce the initial K vacancy. In the high-energy portion of the Auger spectrum, lines at 363.8 eV and 384.7 eV and a band roughly between 368 eV and 380 eV were found as a result of electron bombardment but were missing with the X-irradiation. The reason for these differences is ascribed to the phenomenon of exciting a K electron into an unoccupied molecular orbital followed by autoionization. (auth)

33714 SEPARATION OF ^{103m}Rh FROM ^{103}Pd IN THE FORM OF AN ISOTOPE GENERATOR. Bernhard, H.; Lieser, K. H. (Technische Hochschule, Darmstadt, Ger.). Radiochim. Acta; 13: 134–8(1970). (In German).

Two different methods of producing an isotopic generator for ^{103m}Rh were investigated. The best results were obtained from a milking system based on the fixation of tetrachloro palladate on an anion exchanger. Dowex-2X8 and the macroporous Amberlite IRA-93 resin were used. ^{103m}Rh was eluted with 0.2 m HCl (yield 20 to 25%, decontamination factor $>10^4$, separation time 1 to 6 min). Moreover, the adsorption of palladium diacetyldioxime on alumina was investigated in detail. The elution of ^{103m}Rh was carried out with 0.2 m HCl (yield 7%, decontamination factor 43 to 270, separation time 5 to 6 min). All generators showed high operational safety at maximum load. (auth)

33715 INVESTIGATION OF THE REACTIONS OF THE RECOIL ^{14}C ATOMS IN SOME HETEROGENEOUS MIXTURES. Barakat, M. F.; Zahran, A. H. (Atomic Energy Establishment, Cairo). Radiochim. Acta; 13: 152–6(1970).

Recoil carbon-14 atoms, formed on neutron irradiation of AlN with thermal neutrons, were reacted with benzene, toluene, and benzene–toluene mixture in a trial to investigate the nature of reactions occurring in solid-liquid heterogeneous mixtures. Aluminum nitride was used as a nitrogen donor in order to overcome the difficulties inherent in using organic nitrogen containing compounds. Results showed that a reasonable fraction of the total carbon-14 produced is located in organic combinations. The radiochemical yields of different labeled products formed in the organic phase were determined by radiochemical gas–liquid chromatography. Characteristic reactions of carbon-14 entities are dis-

cussed. The fraction of carbon-14 retained in the AlN solid phase was isolated by a wet oxidation technique and finally obtained in the form of barium carbonate-^{14}C. (auth)

33716 EXCITATION TRANSFER IN THE RADIOLYSIS OF SOLID HYDROCARBONS AS STUDIED BY ESR SPECTROSCOPY AND PRODUCT ANALYSIS. Wakayama, Terunobu; Kimura, Toyoaki; Miyazaki, Tetsuo; Fueki, Kenji; Kuri, Zen-ichiro (Nagoya Univ., Japan). Bull. Chem. Soc. Jap.; 43: 1017-22 (Apr 1970).

The effect of carbon tetrachloride on the radiolysis of isobutane and methylcyclohexane at 77°K was studied by ESR spectroscopy and by product analysis. The yields of solvent radicals from the γ-irradiation of isobutane and methylcyclohexane were not changed by the presence of conventional electron scavengers. This indicated that solvent radicals are not formed by the neutralization of solvent cations with electrons. On the contrary, the yields of solvent radicals decrease remarkably on addition of CCl_4. Though the yield of propylene from the γ-irradiation of isobutane is not affected by the addition of electron scavengers, it decreases significantly on addition of CCl_4. Though the decrease in the hydrogen yield in the radiolysis of methylcyclohexane at 77°K on addition of electron scavengers is only about 1G, it amounts to more than 3.5G on addition of CCl_4. These characteristic effects of CCl_4 can possibly be explained in terms of excitation transfer from the excited solvent molecule to CCl_4. A kinetic treatment suggests that its mechanism may be an exciton transfer. (auth)

33717 DOUBLE RESONANCE STUDIES OF ANIONS FORMED IN IRRADIATED SUCCINIC AND THIODIGLYCOLIC ACID. Wells, James W. (State University Coll., Buffalo). J. Chem. Phys.; 52: 4062-4(15 Apr 1970).

Fast passage ENDOR techniques were applied to the study of the β-proton hyperfine splittings found in the initial carboxylic anions created in irradiated single crystals of succinic acid and thiodiglycolic acid. The associated tensors for each acid were found to be very similar and indicated both were essentially unchanged from the undamaged molecular conformation. For thiodiglycolic acid the hyperfine tensor associated with the polar proton was also determined and shown to be based primarily on hyperconjugation. (auth)

33718 RETENTION OF ^{80m}Br IN (n,γ) IRRADIATED CADMIUM BROMATE CRYSTALS. Arnikar, H. J.; Sharma, D. K.; Patil, S. F. (Univ. of Poona). Radiochim. Acta; 13: 165-7 (1970).

The effect of thermal annealing on the retention of ^{80m}Br in (n,γ) irradiated cadmium bromate dihydrate was studied. The water of crystallization retains radiolytic oxygen during irradiation. This is made available to the ruptured bromine fragments during annealing at 150°C, which is accompanied by dehydration. This results in nearly total retention while the maximum retention at this temperature is only 53% in crystals dehydrated before irradiation. A probable mechanism is suggested. (auth)

33719 REACTION OF ^{82}Br ACTIVATED BY ISOMERIC TRANSITION WITH CH_4 IN THE GASEOUS PHASE. Tachikawa, Enzo; Okamoto, Jiro (Japan Atomic Energy Research Inst., Tokai). Radiochim. Acta; 13: 159-63(1970).

$CH_3{}^{82}Br$ and $CH_2{}^{82}BrBr$ were found as organic products from the reaction with CH_4 of ^{82}Br from isomeric transition in a system containing Br_2. The formation of $CH_3{}^{82}Br$ is sensitive to the addition of moderator, such as He and Xe, although the effect of these additives is not the same. On the other hand, the formation of $CH_2{}^{82}BrBr$ was hardly affected by the addition of Xe, but it could be decreased to some extent by He. It is suggested that $CH_3{}^{82}Br$ and $CH_2{}^{82}BrBr$ are mainly formed via different reaction processes, only one of which is kinetic energy dependent. Referring to the relative ionization potentials of the components in the system, the nature of the kinetic energy independent process is discussed in terms of an ion-molecule reaction of the thermal $^{82}Br^{+1}$. Furthermore, it is inferred from the pressure dependence that $CH_3{}^{82}Br$ from a kinetic energy dependent process is formed with sufficient internal excitation to cause secondary decomposition, in analogy with the experimental observations on other recoil atom reactions. (auth)

33720 ROLE OF TRIFLUOROMETHYL RADICALS IN THE RADIATION POLYMERIZATION OF GASEOUS TETRAFLUOROETHYLENE. Cooper, R.; Roy, C. R. (Melbourne Univ., Parkville, Australia). Aust. J. Chem.; 23: 939-46(Mar 1970).

Mass spectral analysis of the solid polymer produced by radiolysis of gaseous tetrafluoroethylene reveals significant initiation by CF_3 species. In the presence of nitric oxide, CF_3NO is produced, $G(CF_3NO) = 3.11$, and polymerization is completely inhibited. The scavenging of CF_3 radicals by NO in this system yields rate constant data consistent with available data for photochemically produced CF_3 radicals. The mass spectrum of pure C_2F_4 contains a metastable peak, indicating that an ionic rearrangement of $C_2F_4^+$ produces CF_3^+. Ion-molecule reactions producing CF_3 ions and radicals can produce up to 1.17 per ion pair; the observed yield is 1.02 ± 0.05. 3-Methylpentane, acting as a charge-transfer agent, inhibits polymerization. (Australia)

33721 KINETICS OF ELECTRON SCAVENGING AND ION RECOMBINATION IN THE RADIOLYSIS OF HYDROCARBON SOLUTIONS. Rzad, Stefan J.; Infelta, Pierre P.; Warman, John M.; Schuler, Robert H. (Carnegie-Mellon Univ., Pittsburgh). J. Chem. Phys.; 52: 3971-3983(15 Apr 1970).

A functional description of the lifetimes of the ion pairs produced in the radiolysis of pure hydrocarbons was derived from the concentration dependence observed for ion scavenging. A number of consequences that follow from this description are explored. In particular it is shown that in the absence of scavenger the decay of the geminate ions must be very closely described by $F(t) = e^{\lambda t}\mathrm{erfc}(\lambda t)^{\frac{1}{2}}$, where λ is a constant and F(t) is the fraction of ions present at time t. Appropriate descriptions for the growth and decay of secondary ions are given, and the results are applied to real systems of finite pulses. Comparison was made between the predictions given here for the time dependence of the population of secondary negative ions and the experimental observations of Thomas and co-workers on the decay of diphenylide negative ion in pulse irradiated cyclohexane solutions of diphenyl. From this comparison it was concluded that the rate constant for electron scavenging by the diphenyl is $\sim 3 \times 10^{11} M^{-1}/sec^{-1}$ and that the preponderant fraction of ion recombination occurs in the time region of $10^{-11} - 10^{-9}$ sec. (auth)

33722 RADIATION-INDUCED OXIDATION OF SELECTED ORGANICS IN WASTE WATER. Condren, Arthur James. Lafayette, Ind.; Purdue Univ. (1969). 70p.
Thesis.

A review of the principles of radiation chemistry established several variables that could be of significance in the application of ionizing radiation to the oxidative destruction of organics found in waste water. The variables considered to be applicable to these studies were: organic species, concentration of organic species, absorbed radiation dose, concentration of H_2O_2, concentration of dissolved O_2, and combinations of the above. Irradiation of static 30, 90, and 150 mg/l phenol solutions gave a linear rate of removal with respect to total absorbed dose, the rate approximating 22 mg/l COD per megarad for all three concentrations. Prior introduction of hydrogen peroxide enhanced the amount of oxidation which occurred, the amount of removal being a function of both the initial hydrogen peroxide concentration and absorbed radiation dose. Air and oxygen diffusion at a given flow rate enhanced the oxidation; however, increasing the gas flow rates did not increase the amount of radiooxidation. Air pressurization during irradiation of 90 mg/l phenol solutions showed that increased oxidation resulted as pressure on the system increased. COD removal approached a linear removal rate only when 120 psig pressure was employed. Pure oxygen pressurization during irradiation led to linear removals of COD with respect to absorbed dose. The effect of substrate concentration on the amount of radioinduced COD destruction was investigated. Combination of all experimental variables showed that no synergistic effects resulted. A very slight cumulative removal effect was noted, maximum measured COD destruction being about 6% greater than that obtained by single variable treatment. Solutions of phenol, alanine, sucrose, and tannic acid were irradiated in the presence of air diffusion at 300 ml/liter/min and analyzed for COD and organic carbon removals. The COD removals of these solutions followed the general pattern of linear removal followed by a decreasing rate of removal as the substrate concentration became limiting. The organic carbon data for each treated solution showed two distinct linear removal functions as total dose increased, the initial rate being less than the rate obtained at greater total absorbed doses. This occurrence implied that a given amount of fragmentation, oxidation, and hydrolyzation of the parent molecule had to have occurred before maximum oxidation of the organic carbon to carbon dioxide could be obtained. The maximum organic carbon removal rates for phenol, alanine, sucrose, and tannic acid were 17, 17, 23 and 28 mg/l per megarad, respectively. (Diss. Abstr. Int., B)

33723 SPECTROPHOTOMETRIC STUDY OF THE MECHANISM OF RADIATION INACTIVATION AND THE MODIFYING ACTION OF THIOGLYCOLIC ACID ON CATALASE. Momeni, Michael Hoshang. Iowa City, Iowa; Univ. of Iowa (1969). 97p.
Thesis.

Absorption and difference spectroscopy were used to investigate the effect of x-radiation exposure and thioglycolic acid (TGA) on the activity and the structure of the enzyme, catalase. X-irradiation inactivated the enzyme catalase, with what appeared to be an exponential decrease in the % activity with increased radiation

exposure. Possible mechanisms of the radiation inactivation might be: (i) destruction or modification of the heme active sites, (ii) changes in the orientation of the active site groups within the macromolecule, (iii) destruction or alteration of functional amino acids, and (iv) increased inter-intra macromolecular interactions initiated by a modification of the secondary and tertiary structure of the enzyme. The results of these investigations indicate that all of these mechanisms may be involved in the inactivation of catalase by x-irradiation. TGA inhibited the activity of the enzyme. The degree of inhibition was increased with increasing concentration of TGA until a maximum inhibition was obtained. At maximum inhibition the activity of the enzyme was about 50 per cent of the control catalase (with no TGA added) activity. TGA protected the activity of the enzyme when it was present during the irradiation of catalase solution. However, when TGA was added after the radiation exposure no protection was observed. The degree of radioprotection was increased with increasing concentration of TGA until the maximum protection was obtained. A further increase in the concentration of TGA decreased the degree of radioprotection. The effect of various factors such as pH, cupric ion, oxygenation, and x-radiation exposure on the structure of TGA was investigated. These studies indicate that TGA is able to participate in energy-charge-transfer reactions and mixed disulfide formation. These mechanisms might be responsible for the radioprotective and inhibitory effect of thioglycolic acid. (Diss. Abstr. Int., B)

33724 RADIOLYSIS OF PURE ISOBUTYL BROMIDE AND ISOBUTYL BROMIDE WITH ADDITIVES. Bakale, Donna Kutsko. Cleveland; Case Western Reserve Univ. (1969). 244p.

Thesis.

The ^{60}Co γ radiolysis of pure isobutyl bromide and isobutyl bromide with additives (HBr, $i-C_4H_8$, C_2H_4) was studied by total product analysis using gas chromatography up to a dose of 12×10^{18} eV/gm. A free-radical mechanism was proposed to account for the results obtained. The similarity between product formation in radiolysis and photolysis was established and eliminated the presence of ionic reactions in the mechanism. In pure isobutyl bromide, isobutane ($G = 3.2 \pm 0.2$) is the product of initiation and 1,2-dibromo-2-methylpropane ($G = 2.4 \pm 0.4$) is the product of termination. Isobutylene and HBr rapidly reach equal steady-state concentrations (initial G = 17,600) which are independent of dose rate and increase with temperature. The G value for t-butyl bromide production is 40 ± 10. By applying steady-state kinetics equations were derived from the proposed mechanism which account quantitatively for all product formation in pure $i-C_4H_9Br$ and $i-C_4H_9Br$ with HBr or isobutylene added prior to irradiation. Several rate constant ratios can be obtained from the experimental data which are consistent with literature values available for similar reactions of alkyl radicals. A value for the activation energy of bromine atom elimination from $CH_3C(CH_3)CH_2Br$ of ~ 9 kcal/mole was obtained from the behavior of t-butyl bromide formation as a function of additives. The exact value depends on the relative importance of bromine atom elimination-readdition and intramolecular halogen atom shift in the production of t-butyl bromide. Both processes predict identical kinetics and it was not possible to determine their exact relative importance in the experiments of this work. A value for the E_a of the radical decomposition was also obtained from the temperature dependence of HBr and isobutylene concentrations and it was in excellent agreement with the values obtained from the t-butyl bromide data. A change in the nature of the predominant termination reaction from Br–Br to R–R was shown to occur and accounted for changes in G(t-butyl bromide) as a function of additive concentrations. In order to account for the lack of change in G(dibromide) with a change in the nature of termination, it was proposed that any molecular bromide formed adds to isobutylene and that the reaction of two $CH_3C(CH_3)CH_2Br$ radicals results in essentially every case in disproportionation with bromine atom transfer. The expected linearity of G(t-butyl bromide) with the inverse square-root of the dose rate was confirmed. (Diss. Abstr. Int., B)

33725 ESR EVIDENCE FOR THE FORMATION OF Cd(I) IN IRRADIATED $CaCd(OOCCH_3)_4.6H_2O$. Eachus, R. S.; Herring, F. G. (Univ. of British Columbia, Vancouver). Chem. Phys. Lett.; 5: 405–6(15 May 1970).

The cation Cd (I), stabilized as a molecular complex in γ-irradiated single crystals of calcium cadmium acetate hexahydrate, was identified by its ESR spectrum. (auth)

33726 VOLTAMETRIC DETERMINATION OF RADIATION EFFECTS ON L-ASCORBIC ACID IN AERATED AQUEOUS SOLUTION. Cescon, Paolo; Montalti, Maria. Ann. Chim. (Rome); 60: 63–70(1970). (In Italian).

The effects of γ rays on L-ascorbic acid in aerated aqueous solutions were studied by polarography with a new kind of Pt electrode. A dependence of the [G] value on the dose rate and on the initial concentration of vitamin C was found. The decrease in L-ascorbic acid resulted independently from the buffer nature of the solution. (auth)

33727 ESR DETECTION OF A V_K CENTRE IN X-IRRADIATED SARCOSINE HYDROCHLORIDE AT 77°K. Lassman, G.; Damerau, W. (Deutsche Akademie der Wissenschaften, Berlin). Phys. Status Solidi; 39: K89-91(1 Jun 1970).

Besides the free radicals that can be detected at room temperature after x irradiation, an additional paramagnetic center was detected in the ESR spectrum after irradiation at 77°K. The spectrum was interpreted to be due to V_K centers (Cl_2^-), which decrease with annealing to room temperature. (D.L.C.)

33728 CHEMICAL INDUSTRY AND ATOMIC ENERGY. Tsujii, Junro (Ube Industries, Ltd., Yamaguchi, Japan). FAPIG (Tokyo); No. 51, 192–5(Nov 1968). (In Japanese).

The reduction in cost of electric power due to atomic power generation has an influence on the chemical industry, bringing down the cost of products. Dow Chemical Co. of the United States has decided to construct a twin-reactor plant supplying both electricity and steam, jointly with a utility firm. BASF in West Germany has a similar plan. An atomic energy plant in chemical industry must be jointly owned with a utility firm, and the plant must be in the proximity of chemical plants. Ammoniac fertilizer production, aluminum refining, iron and steel manufacture, etc., will be benefited by the low cost of electricity or heat. The relation of the chemical industry and the reactor fuel cycle are considered. (NSA of Japan)

33729 ELECTRON SPIN RESONANCE STUDIES OF RADIATION DAMAGE TO A SINGLE CRYSTAL OF DEOXYADENOSINE MONOHYDRATE. Lichter, James Joseph. Durham, N. C.; Duke Univ. (1969). 106p.

Thesis.

Single crystals of deoxyadenosine monohydrate were grown from a solution of D_2O, irradiated with γ rays, and studied at room temperature with a 9.5-GHz electron spin resonance (ESR) spectrometer. Three free radicals were observed. One radical decayed too rapidly for its spectra to be recorded; A second radical was produced on the deoxyribase sugar and its spectra are described, and the third radical is due to a hydrogen addition reaction with the adenine ring. A detailed analysis was made of the resulting spectra. The unpaired electron couples through hyperconjugation to the $C_{(2)}H_2$ methylene protons giving an approximately isotropic triple with intensity ratios 1:2:1 and a component spacing of 43.7 ± 0.5 gauss. The anisotropic substructure, which is due to coupling to the $N_{(1)}$ and $N_{(3)}$ nuclear moments, indicates the unpaired electron has spin densities of 0.17 on $N_{(1)}$ and 0.37 on $N_{(3)}$. These values are compatible with the theoretical calculations. All the recorded spectra indicate that the coupling to the nitrogen nuclei is axially symmetric with principal values $A_\perp^{N(1)} = A_\perp^{N(3)} = 0$, $A_\parallel^{N(1)} = 8.7 \pm 0.5$ gauss, and $A_\parallel^{N(3)} = 19.0 \pm 0.5$ gauss. The g-tensor could not be obtained precisely, although it appeared to be axially symmetric with the same principal axes as the hyperfine tensor. With this assumption, and by use of the DPPH resonance ($g = 2.0036$) as a reference marker, the principal values obtained were $g_\parallel = 2.0030 \pm 0.0005$ and $g_\perp = 2.0050 \pm 0.0005$. (Diss. Abstr. Int., B)

33730 ELECTRON SPIN RESONANCE STUDIES OF RADIATION DAMAGE. PART III. GAMMA IRRADIATED ACETONITRILE. Sargent, F. P. (Univ. of Saskatchewan, Saskatoon. Univ. of Leeds, Eng.). Can. J. Chem. 48: 1780–1(1 Jun 1970).

The effects of photobleaching and thermal decay at 77 and 87°K on the electron spin resonance spectra of gamma-irradiated acetonitrile are reported. Samples of acetonitrile gamma irradiated and examined in the dark at 77°K gave spectra consisting of a quartet of intensity ratios approximately 1:3:3:1 with linewidths of 2.6 G and a hyperfine splitting of 21.8 ± 0.2 G. There was a large increase in the intensity of the quartet spectrum when the samples were photobleached. The quartet decayed thermally at 77°K with one enhancement during exposure to light. Examination of the gamma irradiated samples in the dark at very low microwave power levels, i.e., less than 50 μW, indicated the presence of a singlet in the ESR spectrum which was irreversibly removed by exposure to light. (J.G.B.)

33731 RADIATION VULCANIZATION OF POLYISOBUTYLENE (PIB) IN THE PRESENCE OF PARA-DIVINYLBENZENE (DVB). Kim, I. P.; Barkalov, I. M.; Egorov, E. V. Khim. Vys. Energ.; 4: 81–2(Jan-Feb 1970). (In Russian).

Samples of polyisobutylene (PIB) were impregnated with 1.4, 9, 15, and 25% divinylbenzene (DVB) by exposure to DVB vapors for varying lengths of time. The impregnated samples were given a ^{60}Co gamma dose of 2 to 30×10^6 rads. This irradiation in the

presence of DVB lies to the formation of large amounts of a gel fraction, which substantially exceeded the amount of DVB present. The maximum amount of gel was 85% at a concentration of 25% DVB. The optimum dose for the accumulation of gel was equal to 2 to 4×10^6 rads. With a further increase of irradiation dose a fall in gel content was noted. The molecular weight of the gel was estimated to be 10^3 to 10^5. Infrared studies showed that the PIB is crosslinked with the DVB to form a three-dimensional structure. (TTT)

33732 EFFECT OF THE UNSHARED ELECTRON PAIR OF THE NITROGEN ATOM ON THE PHOTOCHEMICAL PROPERTIES OF RADICALS IN IRRADIATED AMINES. Kotov, A. G.; Pukhal'skaya, G. V.; Pshezhetskii, S. Ya. Khim. Vys. Energ.; 4: 93-5 (Jan-Feb 1970). (In Russian).

On irradiation with gamma rays, a radical is formed by removal of the hydrogen atom in an alkyl group. The absorption spectrum of this radical is shifted to the long-wavelength region, as compared with the absorption spectrum of the initial molecule. This absorption shift in a radical differing from the initial molecule by the absence of a single hydrogen atom is apparently related to the interaction of an unpaired electron with the unshared electron pair of the nitrogen atom. To test this hypothesis the following alkylamines were given a gamma dose of 5×10^6 rads with subsequent examination of their EPR spectra: $CH_3NH_2 \cdot HCl$, $(CH_3)_2NH \cdot HCl$, $(CH_3)_3N \cdot HCl$, $C_2H_5NH_2 \cdot HCl$, $(C_2H_5)_2NH \cdot HCl$ and $(C_2H_5)_3N \cdot HCl$. The superfine structure of the EPR spectra of a number of the irradiated alkylamines showed that the alpha and beta protons were not equivalent. The data were found to support the hypothesis presented above. (TTT)

33733 RADIOLYSIS OF AQUEOUS SOLUTIONS OF A NUMBER OF ORGANIC SUBSTANCES. Brusentseva, S. A.; Dolin, P. I.; Shubin, V. N.; Pribush, A. G. (Inst. of Electrochemistry, Moscow). Khim. Vys. Energ.; 4: 88-9(Jan-Feb 1970). (In Russian).

Radiation yields for the breakdown of phenol, picric acid, decyl sulfonate, and an organic thiophosphate compound were determined in a 4×10^{-4} molar solution saturated with air after irradiation with ^{60}Co at a dose rate of 3×10^{15} eV/cm^3-sec. The radiation yield increased to 4.0 molecules/100 eV. The addition of hydrogen peroxide or increasing the pH of the solution had no effect on the breakdown yield. On increasing the temperature above 60°C, the breakdown yield of decyl sulfonate increases to 8.5 molecules/100 eV, but on decreasing the concentration by a factor of 2, the yield falls to 4.0 molecules/100 eV. In solutions saturated with nitrogen the initial yield at 80°C remains unchanged at 2.3 molecules/100 eV. These results indicate that HO_2 radicals are involved in the oxidation reaction by means of a short chain reaction at the beginning of the reaction. More careful study is required to evaluate the conditions under which the development of a chain reaction is possible. (TTT)

33734 RADIOCHEMICAL SYNTHESIS OF HYDROGEN CYANIDE UNDER FLOW CONDITIONS. Dzantiev, B. G.; Popov, V. N.; Smelova, Yu. N. (Inst. of Chemical Physics, Moscow). Khim. Vys. Energ.; 4: 86-7(Jan-Feb 1970). (In Russian).

The synthesis of hydrogen cyanide (HCN) from gaseous mixtures of nitrogen or ammonia and methane, ethylene, or acetylene irradiated with 600 keV electrons was investigated as a function of the composition of the binary system and temperature. The volume of the reactor was 9.2 liters. The irradiation dose was about 10^{15} eV/cm^2-sec. The gas flow rate was 400 to 900 1/hr, which corresponded to a contact time of 36 to 82 sec in the reactor. The G values for HCN production are given for the various mixtures with a maximum G value of 3.0 for ammonia–methane mixtures. The HCN yield increases with temperature up to 250°C. (TTT)

33735 RADIOCHEMICAL TRANSFORMATIONS OF POLY(VINYL FLUORIDE). Usmanov, Kh. U.; Yul'chibaev, A. A.; Latypov, T. (Tashkent State Univ.). Uzb. Khim. Zh.; No. 2, 63-6(1970). (In Russian).

Gamma radiation effects on the physical and chemical properties of poly(vinyl fluoride) were studied using material prepared by γ-induced polymerization with an integral dose of 0.5 Mr. Subsequent irradiations were carried out in a 10^{-3} mm Hg vacuum with a wide range of doses. Tabulated data showed that gamma irradiation results in a destructive splitting of HF from the molecule, breakup of macromolecules and formation of crosslinked polymers. (R.V.J.)

33736 RADIATION CHEMISTRY OF ORGANIC PHOSPHORUS COMPOUNDS. Drawe, H. (Kernforschungsanlage, Juelich, Ger.). Radiochim. Acta; 13: 81-9(1970). (In German).

Radiochemical methods of synthesis of phosphoric compounds and the kinetics of such reactions are surveyed. Numerous new compounds were synthesized recently in this way. Since some phosphoric compounds are being used in the nuclear industry knowledge of their behavior under the influence of high-energy radiation is important. Moreover, some aspects of the synthesis of ^{32}P-labeled compounds are discussed. (auth)

33737 ESR STUDY OF THE BEHAVIOR OF H ATOMS TRAPPED IN FROZEN PERCHLORIC ACID SOLUTIONS. Ultee, C. J.; Kepford, C. R. (United Aircraft Research Labs., East Hartford, Conn.). J. Chem. Phys.; 52: 3462-7(1 Apr 1970).

Aqueous solutions of perchloric acid were irradiated at 77°K with ^{60}Co γ rays and then examined by ESR spectroscopy. The H atoms formed in these systems are stable at 77°K and decay only on warming the samples. The kinetics of the H-atom decay were examined in detail for 0.13 mole fraction $HClO_4$ solutions over the temperature range 100 to 130°K. There are two types of trapped H atoms, both of which decay with first-order kinetics. The least stable type has a decay rate constant given by $k = 1.84 \times 10^3 \exp(-3.24 \times 10^3/RT)$ sec^{-1} and the second-type decays with a rate constant given by $k = 9.43 \times 10^{10} \exp(-8.02 \times 10^3/RT)$ sec^{-1}. The first-order decays are interpreted as resulting from a mechanism which has an activated release of H atoms from their traps as the rate-determining step. The resulting mobile or free H atoms then react rapidly with other radicals to complete the reaction. Based on this mechanism, the trapping energies for the two types of sites are 3.24 and 8.02 kcal/g atom, respectively. (auth)

33738 CHEMICAL EFFECTS OF THE (n,γ) REACTION IN CHLOROPENTAAMMINE COMPLEXES OF COBALT(III), RHODIUM(III), AND IRIDIUM(III). Gardner, E. R. (Leicester Polytechnic, Eng.); Gravenor, M. E.; Harding, R. D.; Raynor, J. B.; Autchakit, R. Radiochim. Acta; 13: 100-4(1970).

Chloropentaamminecobalt(III) chloride, chloropentaammine-rhodium(III) chloride and chloropentaammineiridium(III) chloride labeled with ^{36}Cl in the cation were irradiated with thermal neutrons in a flux of 10^{11} neutrons cm^{-2} sec^{-1} for ten hours. Study of the effects of the (n,γ) reaction showed that, in the case of the cobalt and rhodium complexes, there is retention of the ^{36}Cl in the cation, but in the case of the iridium complex about 90% of the Ir–^{36}Cl bonds are broken while only one in 10^6 iridium atoms are activated. The results are interpreted using a modification to the hot zone theory of Harbottle and Sutin. An attempt was made to identify some of the species formed on dissolution in water. (auth)

33739 GAMMA RADIATION EFFECTS ON GRAFTING OF METHYL METHACRYLATE TO POLY(VINYL FLUORIDE). Latypov, T.; Yul'chibaev, A. A.; Usmanov, Kh. U. (Tashkent State Univ.). Uzb. Khim. Zh.; No. 1, 53-6(1970). (In Russian).

Effects of ^{60}Co γ radiation on the graft polymerization of methyl methacrylate (MMA) to poly(vinyl fluoride) (PVF) in a vacuum were studied at radiation doses of 12, 24, 50, and 100 r/sec. It was shown that increased doses of γ radiation inhibited the efficiency of the grafting process indicating a high radiosensitivity of the MMA monomer and easy destruction of the grafted chain of poly(methyl methacrylate) (PMMA) by γ rays. Studies of the ir spectra of grafted copolymers, homopolymers, density, and swelling kinetics in different solutions were made. The results showed that the magnitude of equilibrium swelling depends on the composition of the co-polymer and the solvent. The density and flow temperature of grafted copolymers diminished with increased content of PMMA. (R.V.J.)

33740 STRUCTURE OF FREE RADICALS IN γ-IRRADIATED POLYPROPYLENE (PP). Klinshpont, E. R.; Milinchuk, V. K. Khim. Vys. Energ.; 4: 84-5(Jan-Feb 1970). (In Russian).

Samples of polypropylene (PP) were given a gamma dose of 20×10^6 Rads at 77°K. The superfine structure of the EPR spectra was investigated after radiolysis at 77°K and after irradiation with ultraviolet light. The data can best be explained by the formation of allyl radicals having two structures whose EPR spectra differ significantly from each other. The structures of the allyl radicals are presented. (TTT)

33741 EVIDENCE FOR THE DRY CHARGE PAIR IN THE RADIOLYSIS OF WATER. Sawai, Takeshi (Tokyo Metropolitan Isotope Research Center, Setagaya, Japan); Hamill, William H. J. Chem. Phys.; 52: 3843-4(1 Apr 1970). (COO-38-709).

The dry hole in water (H_3O^+ or $H_5O_2^+$) can be expected to undergo trapping by anions at high concentrations. Some prompt recombination of the dry $H_2O^+ - e^-$ pair is expected because the 100-eV yield of e^-_{aq} is only 2.7. The relative probabilities of trapping and "first-order" processes were considered. (M.C.G.)

33742 ISOTOPE AND CONCENTRATION EFFECTS OF BROMINE IN POLYCRYSTALLINE BENZENE AT 77°K. Kemnitz, E. J.; Hahn, H. K. J.; Rack, E. P. (Univ. of Nebraska, Lincoln). Contract AT(11-1)-1617. Radiochim. Acta; 13: 112-14(1970). (COO-1617-15).

Organic yields from the nuclear processes $^{79}Br(n,\gamma)^{80m}Br$, $^{81}Br(n,\gamma)^{82}Br$, $^{81}Br(n,\gamma)^{82m}Br$, and $^{82m}Br(IT)^{82}Br$, were studied in bromine–benzene systems to gain information on isotope effects and the state of aggregation of the bromine in benzene. (M.C.G.)

33743 RECOIL CHEMISTRY OF ^{51}Cr IN THE HEXAMMINE-COBALT(III) COMPLEX AND CHROMATE SYSTEM. Ikeda, Nagao; Saito, Kenji; Tsuji, Kunio (Tokyo Kyoiku Univ.). Radiochim. Acta; 13: 90–4(1970).

The recoil substitution reaction between outer-sphere Cr recoil atom and central Co atom was investigated using $[Co(NH_3)_6]_2(CrO_4)_3 \cdot 5\ H_2O$ (Sample A) as well as the mixture of $[Co(NH_3)_6]Cl_3$ and K_2CrO_4 crystal powders (Sample B) as the target materials. Each target material was irradiated by reactor neutrons, and the radiochemical yield of ^{51}Cr produced in the form of $[Cr^*(NH_3)_6]^{3+}$, $Cr^*O_4^{2-}$ or Cr^{*3+} was determined. The initial radiochemical yield of ^{51}Cr activity found in the $[Cr^*(NH_3)_6]^{3+}$ form was 1.6 ± 0.2% for sample A and 0.9 ± 0.1% for sample B, and the corresponding retention values were 10.3 ± 0.3% and 61.7 ± 0.6%, respectively. Thermal annealing experiments were carried out with both the systems at 60, 70 and 80°C. Each annealing curve of the $[Cr^*(NH_3)_6]^{3+}$ fraction showed rather rapid increase of the radiochemical yield at the earlier stage, and then nearly exponential decrease. The mechanisms of the substitution reaction and of the annealing process of the $[Cr^*(NH_3)_6]^{3+}$ fraction are discussed. (auth)

33744 PULSE RADIOLYSIS OF ETHANOL. Fletcher, J. W.; Richards, P. J.; Seddon, W. A. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Chem.; 48: 1645–50(1 Jun 1970). (AECL–3533).

The radiation chemistry of ethanol was investigated by pulse radiolysis with emphasis on the decay kinetics and yield of the solvated electron, e^-_{EtOH}, in neutral and alkaline solution. Computer calculations show that the experimental data are most consistent with a yield $G(e^-_{EtOH}) = 1.7$ molecules/100 eV, and a pseudo first-order half-life for e^-_{EtOH}, $t_{\frac{1}{2}} \approx 6\ \mu s$, which corresponds to a second-order rate constant $k(e^- + EtOH) = 7 \times 10^3\ \underline{M}^{-1}\ s^{-1}$. Rates of reaction of the electron with acetaldehyde and C_6F_{12} were determined to be $4.0 \pm 0.5 \times 10^9$ and $2.5 \pm 0.5 \times 10^9\ \underline{M}^{-1}\ s^{-1}$, respectively. The empirical square root formula for spur scavenging kinetics, $G(e^-_{obs}) = G_{(fe)} + G_{(ge)}(\sqrt{\alpha s}/1 + \sqrt{\alpha s})$, is obeyed for scavenging of the radiation-produced positive ion. (auth) (Canada)

33745 RADIATION CHEMISTRY OF GASEOUS OXYGEN: EXPERIMENTAL AND CALCULATED YIELDS. Willis, C. (Atomic Energy of Canada Ltd., Chalk River, Ont.); Boyd, A. W.; Young, M. J.; Armstrong, D. A. Can. J. Chem. 48: 1505–14 15 May 1970). (AECL–3574).

The yield of ozone from the radiolysis of gaseous oxygen was measured at $10^{26} - 10^{27}$ eV g^{-1} s^{-1} to be $G(O_3) = 12.8 \pm 0.6$. At 10^{16} eV g^{-1} s^{-1}, results and re-examination of previous data give $G(O_3) = 6.2 \pm 0.6$. The same value is obtained at the high dose rates by the addition of electron scavengers. The difference in yields on going from high to low dose rates and the decrease with electron scavengers at the high dose rate is explained by differences in ion neutralization processes. These are supported by computer calculations. The mechanism of the neutralization steps is discussed in terms of the applicability of the electron jump theory and the effect of clustering of the ions. The proportion of energy lost to ionization, excitation, and subexcitation electrons is calculated. This is based on the W value, relative cross sections for ionization, and the potential energy curves for O_2^+ ions. A predicted yield on this basis is $G(O_3) = 14.0 \pm 0.9$, in fairly good agreement with the experimental yield. (auth) (Canada)

33746 RADIOLYSIS OF AIR AND NITROGEN–OXYGEN MIXTURES WITH INTENSE ELECTRON PULSES: DETERMINATION OF A MECHANISM BY COMPARISON OF MEASURED AND COMPUTED YIELDS. Willis, C.; Boyd, A. W.; Young, M. J. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Chem. 48: 1515–25(15 May 1970). (AECL–3575).

Air and other mixtures of nitrogen and oxygen containing from 0.1 to 100% oxygen were irradiated with single, 0.12-Mrad electron pulses at a dose rate of 2×10^{26} eV g^{-1} s^{-1}. The major product formed in these irradiations is ozone. For air from 400–1500 Torr, $G(O_3) = 10.3 \pm 0.5$, the addition of SF_6 reduces this by 5.8 ± 0.5 G units. The yield of ozone from other nitrogen–oxygen mixtures varies with the concentration of oxygen. At both 700 and 1500 Torr total pressure for 1 Torr of O_2, $G(O_3) \approx 4$. This increases with oxygen concentration to a maximum of $G(O_3) = 12.8$ for pure oxygen. For all the above conditions the yield of nitrogen dioxide is below the limits of detection. A mechanism is proposed based on known possible ionic and neutral reactions and their rate constants. Detailed computer calculations using this mechanism give results which compare well with the experimental yields. These results are consistent with an assumed yield of G(N) = 6 from processes involving neutral species in the radiolysis of pure nitrogen. (auth) (Canada)

33747 IDENTIFICATION OF THE RADICALS PRODUCED BY GAMMA RAYS IN SOLID MIXTURES OF CYCLOPENTANE–NEOHEXANE. Dodelet, J. P.; Fauquenoit, C.; Siquet, M.; Claes, P. (Univ., Louvain, Belgium). Ann. Soc. Sci. Brux. Ser. I; 84: No. 1, 107–16(25 May 1970). (In French).

The ESR spectra of radicals produced by γ rays in pure cyclopentane and neohexane and in mixtures of these components were interpreted. Summation of the single spectra was tried in order to obtain the experimental spectra of mixtures. The differences observed between the experimental and calculation spectra were attributed to the differences in the physical properties of the matrix. This influence is particularly noticeable when the sample changes from the crystalline to the vitreous phase. (auth)

33748 RADIOLYSIS OF ALKYLAROMATIC AMINES IN TWO-PHASE, AQUEOUS–ORGANIC SYSTEMS. Kershulis, V. I.; Egorov, G. F.; Zagorets, P. A. (Inst. of Electrochemistry, Moscow). Khim. Vys. Energ.; 4: 91–2(Jan–Feb 1970). (In Russian).

Irradiation with 5-MeV electrons at a dose of 1.4×10^{18} eV/ml-sec was carried out in the presence and absence of oxygen on 0.2 molar solutions of benzyldinonylamine (BDNA), dibenzyldodecylamine (DBDA), and dinonylaniline (DNA) in n-butylbenzene and n-octane containing 30 wt % of n-octyl alcohol in contact with an equal volume of an equilibrium 2.0 M solution of aqueous nitric acid. The rate of amine breakdown was the same in the presence and absence of oxygen. In the absence of nitric acid the radiation breakdown yields of DNA, DBDA and BDNA were respectively 1.0, 2.4, and 3.3 molecules/100 eV in octane solution, and 2.9, 3.1, and 3.6 moles/100 eV in butylbenzene solution. Irradiation of the amines in contact with nitric acid increased the radiation breakdown yields to 13, 3.4, and 4.1 molecules/100 eV respectively for DNA, DBDA and BDNA in octane, and to 96, 2.6, and 2.6 molecules/100 eV in butylbenzene. The high breakdown of DNA is caused by the formation of a nitrosoamine by DNA in the presence of nitrous acid, as shown by infrared spectra. The breakdown yields of octyl alcohol were found to be 13, 5.8, and 5.8 molecules/100 eV respectively for solutions of DNA, DBDA and BDNA. (TTT)

33749 LIGHT HYDROCARBONS FROM THE DESTRUCTION OF BENZENE BY TRITIUM RECOIL ATOMS. Avdonina, E. N. (Moscow State Univ.). Khim. Vys. Energ.; 4: 83–4(Jan–Feb 1970). (In Russian).

Liquid benzene was irradiated in the presence of a lithium carbonate powder with thermal neutrons at a flux of 1.2×10^{13} neutrons/cm^2-sec for 15 min. at a temperature of 70°C. Gas chromatographic analysis showed the presence of noticeable amounts of acetylene, and also of ethylene and butadiene. The content of acetylene increased approximately a factor of 2 on introducing iodine at a rate of 5×10^{-2} mols/l. Since the specific activity of acetylene is approximately an order of magnitude higher than its specific activity during formation as a result of the radiolysis of tagged benzene, it is assumed that the formation of the light tagged hydrocarbons is initiated by tritium recoil atoms. It is proposed that an intermediate excited molecule of benzene breaks down with the evolution of one or a number of molecules of acetylene. (TTT)

33750 CHEMICAL EFFECTS OF RECOIL BROMINE ATOMS IN NEUTRON-IRRADIATED N-BUTYL BROMIDE. Ronneau, C.; Cara, J.; Apers, D. J.; Capron, P. C. (Univ., Louvain, Belg.). Radiochem. Radioanal. Lett.; 4: 65–72(3 Jun 1970).

Thermal-neutron-irradiated samples of butyl bromide were analyzed by means of gas chromatography. The effects of added oxygen and aniline were studied. An isotopic effect was clearly observed in the distribution of radioactivities among the organic fractions produced during irradiation. (auth)

Radiochemistry

Refer also to abstracts 33657 and 33704.

33751 STUDIES OF THE BEHAVIOUR OF CARRIER-FREE RADIOISOTOPES. IV. SOME BEHAVIOURS OF CARRIER-FREE ^{31}Si FROM THE VIEW POINT OF RADIOCOLLOID FORMATION. Ichikawa, Fujio; Sato, Tadashi (Japan Atomic Energy Research Inst., Tokai). Radiochim. Acta; 13: 69–71(1970).

The role of silicon compounds in the formation of radiocolloids was studied by means of carrier-free ^{31}Si. The results of centrifugation and ion exchange show that carrier-free ^{31}Si exists in soluble states at all p_H-ranges studied. It is probable that a trace

quantity of silicon compound, which dissolves from the wall of glass vessels into the solution, does not act as the nucleus for the formation of adsorption radiocolloids. (auth)

33752 REACTIONS INITIATED BY THE β-DECAY OF MOLECULAR TRITIUM IN SYSTEMS CONTAINING NOBLE GASES. Cacace, F.; Cipollini, R.; Ciranni, G. (Univ., Rome). Radiochem. Radioanal. Lett.; 4: 51-8(3 Jun 1970).

When molecular tritium is allowed to decay in the presence of noble gases, the primary daughter ions HeT^+ can undergo an exoergic triton transfer, according to the general reaction: $HeT^+ + Y \rightarrow He + YT^+$(where Y = noble gas), which represents a convenient route for the preparation of the tritide ions of the noble gases. These can be regarded as strong Brønsted acids, and are expected to react with any gaseous organic compound to yield tritiated products that can be separated and analyzed by radio gas chromatography. The results obtained from the study of the gas-phase tritonation of CH_4 with the noble gases tritide ions are briefly outlined, and discussed in the light of relevant mass spectrometric data so far available. (auth)

Separation Processes

Refer also to abstracts 33722, 33835, and 36044.

33753 (ARH-1455) RHODIUM RECOVERY TEST: DIRECT REDUCTION ON ZINC OR TIN IN ALKALINE PUREX WASTES. Panesko, J. V. (Atlantic Richfield Hanford Co., Richland, Wash. Separations Chemistry Lab.). Nov 1969. 13p. Dep. CFSTI.

Recovery of rhodium from alkaline Purex wastes by direct reduction on mossy Zn or mossy Sn was less than 0.4%. Greater surface area and longer contact times did not improve overall Rh recovery. Pretreatment of Rh feed with activated carbon removed Pd and Tc. (auth)

33754 (BNWL-1401) FIXATION OF RADIOACTIVE RESIDUES. Research and Development Activities Quarterly Progress Report, February-April 1970. Blasewitz, A. G. (ed.) (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). May 1970. Contract AT(45-1)-1830. 62p. Dep. CFSTI.

Twenty-nine radioactive demonstrations in WSEP were completed with simulated wastes containing approximately 45 MCi of mixed radionuclides being converted to solids. Approximately 4.5 MCi of radioactivity were processed during the eleventh and twelfth spray solidification runs. Spray solidification Run SS-11 processed a simulated Purex Waste typical of that which would result from the reprocessing of a LMFBR core fuel (100,000 MWd/tonne at 200 MW/tonne) and marked the completion of WSEP spray solidifier runs using a high temperature platinum melter. Spray Solidification Run SS-12 (IPM) was successfully completed using the Battelle-Northwest developed in-pot melting technique. During this run spray calcined PW-4m waste was melted with a borosilicate glass frit directly in the final storage container without the need for a platinum melter. That only 1.9% of the ruthenium in the feed processed was volatilized from the spray solidifier during Run SS-12 (IPM) verifies the results of developmental runs, which indicated that the ruthenium volatilization from the spray solidifier was significantly reduced when phosphoric acid was not added to the feed. A method for determining ^{106}Ru in the spray solidifier and phosphate glass solidified waste products was successfully developed. The technique involves the direct gamma scan of the solid samples, and unlike previous dissolution techniques routinely gives high ruthenium recoveries. (auth)

33755 (DOCKET-50201-37) WEST VALLEY REPROCESSING PLANT. Technical Specifications, Change No. 11. (Division of Materials and Licensing (AEC), Washington, D. C.). 19 Jun 1970. 3p. Dep. CFSTI.

The possession and use of up to 5 mCi ^{85}Sr as a tracer in investigation and evaluation of liquid waste treatment systems are authorized. (M.C.G.)

33756 (DOCKET-50332-13) BARNWELL NUCLEAR FUEL PLANT. License Application, Addendum No. 6. (Allied-Gulf Nuclear Services, Florham Park, N. J.). 19 Jun 1970. 2p. Dep. CFSTI.

Information on waste disposal is presented in support of an application for licensing. (M.C.G.)

33757 (EUR-4409) PROCESSING OF IRRADIATED ^{241}Am TARGETS BY ION EXCHANGE AND EXTRACTION. Mueller, W.; Maino, F.; Toussaint, J. Cl. (European Atomic Energy Community, Karlsruhe (West Germany). European Transuranium Elements). Jan 1970. 26p. (CONF-690532-1). Dep. CFSTI (U. S. Sales Only). FF 4.45.

From 5th Conference on Radiochemistry, Zivikov-Castle, Czechoslovakia.

The processing of neutron-irradiated ^{241}Am targets includes: removal of the cladding and matrix material; removal of fission products; isolation of the plutonium (^{238}Pu, ^{242}Pu) fraction; and isolation of the transplutonium nuclides. Plutonium, together with some of the fission products (Zr-Nb, Ru-Rh), is isolated by anion exchange or extraction with substituted ammonium salts from hydrochloric acid solution. Lanthanides may be removed from the transplutonium elements by anion exchange or tertiary ammonium salt extraction from concentrated lithium chloride solutions or by extraction with bis(2-ethylhexyl) phosphate (HDEHP) from aqueous phases containing complexing agents. The separation of americium and curium from each other is possible by selective oxidation and precipitation of the americium or by extraction chromatography with quaternary ammonium salts from lithium nitrate solutions. Several of these methods were combined to process two sets of ^{241}Am targets, exposed to integrated fluxes of 10^{21} and 1.7×10^{22} n/cm², respectively. A mixture of ^{241}Am and ^{242}Cm recovered from the first set of targets and containing about 450 mg ^{242}Cm was welded into a platinum capsule. This heat source served to power a radionuclide battery. (auth) (Euratom)

33758 (LIB-Trans-269) SEPARATION OF ZIRCONIUM AND HAFNIUM, AND THE PREPARATION OF HAFNIUM DIOXIDE BY THE METHOD OF SELECTIVE EXTRACTION OF THE THIOCYANATE FROM ETHYL ACETATE. Vinarov, I. V.; Gertsenshtein, E. S.; Beek, G. I.; Kovaleva, I. E. Translated by V. Gavrilоff (Australian Atomic Energy Commission Research Establishment, Lucas Heights), from Ukr. Khim. Zh.; 34: 153-5(1968). 10p. Dep. CFSTI (U. S. Sales Only).

An abstract of this paper, prepared from the original language, appeared as NSA 22: 23117.

33759 (LF-41, pp 75-81) A NEW METHOD FOR THE MULTICURIE SEPARATION OF ^{90}Y FROM ^{90}Sr. Kanapilly, G. M.; Newton, G. J. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.).

A simple and economical method for the separation of ^{90}Y from $^{90}Sr-^{90}Y$ mixture is described. The method consists of forming colloidal yttrium hydrogen phosphate under precisely controlled conditions and separating the ^{90}Y from ^{90}Sr by filtration. Optimum conditions were established to obtain the highest ^{90}Y yield with the lowest contamination. These conditions were a pH of 5.0, an yttrium carrier concentration of 7 μg/ml, and a strontium carrier concentration of 1 mg/ml. In a double separation, the ^{90}Y recovery was almost 100% and the ^{90}Sr contamination was less than 10^{-6}% of the ^{90}Y. The half-life of ^{90}Y obtained was determined to be 62.8 ± 0.1 hr, a lower value than the 64.3 hr presently noted by the International Atomic Energy Agency. This method was used to prepare 40 Ci of ^{90}Y with a specific activity of 5×10^4 Ci/g for use in toxicity studies. The total time required for the production of ^{90}Y involving a double separation is about 2 hr. For the multicurie ^{90}Y separation, a manipulator cell with simple hand-made equipment was used. With appropriate changes, the same separation procedure was used to separate mCi quantities of ^{140}La from ^{140}Ba. (auth)

33760 (ORNL-TM-3015) THORIUM FUEL CYCLE DEVELOPMENT PROGRESS REPORT NO. 9, APRIL 1970. (Oak Ridge National Lab., Tenn.). Jun 1970. Contract W-7405-eng-26. 34p. Dep. CFSTI.

Progress is reported on head-end reprocessing development, refabrication development, materials irradiation, LWBR support program, and ^{233}U reprocessing. (M.C.G.)

33761 (ORNL-tr-2320) REPROCESSING OF THORIUM-CONTAINING NUCLEAR FUELS. Second Semiannual Activity Report, 1969. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Chemische Technologie). Translated for Oak Ridge National Lab., Tenn., from German report. 63p. Dep. CFSTI.

Research was continued on three versions of the process: the THOREX flowsheet, the KFA-TBP 23/25 flowsheet, as well as the CHLORINEX flowsheet. Preliminary studies were made on radioactive waste treatment with a view toward safe final disposal. Experiments to burn graphite fuel elements with pyrolytic carbon-coated particles in a small fixed bed-fluidized bed model furnace were completed. Work in the field of solvent extraction concentrated on the behavior of uranium and acid in the back-extraction battery. The milling plant to reduce the fuel elements in the CHLORINEX process is almost completed. Isolation of neptunium and plutonium from the THOREX extraction cycle is being studied. (M.C.G.)

33762 (RCN-113) PROPERTIES OF TRILAURYLMETHYLAMMONIUM NITRATE AS AN EXTRACTANT FOR TRIVALENT ACTINIDES. van Ooyen, J. (Reactor Centrum Nederland, Petten). Feb 1970. 101p. Dep. CFSTI (U. S. Sales Only).

The extraction of trivalent Ac, Pu, Am, Cm, Bk, Cf, Es, Ce, and

Eu from acidified lithium nitrate solutions into $TLMANO_3$/o-xylene was investigated. The extraction properties of $TLMANO_3$ (trilaurylmethylammonium nitrate) are largely influenced by its acid binding properties and the formation of oligomers in solution. The existence of the complex $TLMANO_3 \cdot HNO_3$ is substantiated by potentiometric two-phase titrations; the formation of oligomers by differential vapour pressure measurements. $TLMANO_3$ in o-xylene solution forms dimers, trimers, and higher oligomers, mainly pentameters. In the metal complexes two organic ligands are present per metal ion and these ligands can be monomers, dimers, or trimers, but no higher oligomers. A separation of Am and Cm by column extraction chromatography is described, which gives a separation factor of 3.5. (auth)

33763 (UJV-2340-Ch) CHEMICAL PRECIPITATION METHODS. COMPARATIVE STUDY. Hajek, L.; Hajkova, J. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). 1970. 52p. Dep. CFSTI (U. S. Sales Only).

Decontamination methods (chemical precipitation) for low and intermediate level active liquid wastes used on a worldwide scale are described. The fundamental problems of chemical precipitation, coagulation, sedimentation, and the problems of sludge treatment are considered. The experimental part deals with verification of the selected methods on typical liquid radioactive wastes. The results indicate that any of the selected methods of chemical precipitation has neither a universal character nor sufficient efficiency for the decontamination of liquid radioactive wastes, if used separately, nor an expressive advantage from the viewpoint of a pretreatment for further decontamination procedures. This fact is significant mainly from the viewpoint of a future conception of a decontamination plant in NRI based on an automated and programmed process. (auth)

33764 (Y-MA-3582) CHEMICAL RECOVERY SYSTEM FOR SAFEGUARDING UNIRRADIATED URANIUM. Barkman, J. R. (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). 1 Jul 1970. Contract W-7405-eng-26. 23p. Dep. CFSTI.

To safeguard nuclear materials, the chemical recovery of unirradiated forms of enriched uranium is essential to prevent the accumulation of large inventories of fabrication scrap with questionable uranium measurements or estimates. The Oak Ridge Y-12 Plant processed and recovered various forms of unirradiated enriched uranium since 1944. The Y-12 system was designed to receive most forms of fabrication scrap and process it to a high-purity product. The recovery flow consisted of a preliminary chemical treatment followed by a continuous organic purification process that produced uranyl nitrate in solution form. Subsequent processing converted the solution to chemical compounds or the metal. It is very important to properly classify the different forms of uranium prior to recovery. To accomplish this, a classification system is in use that is comprised of seven major categories and many subcategories. This system was valuable in the identification of containers in storage and shipment. In addition, the system provided reliable information for estimating the uranium content of fabrication scrap and thus permitted the recovery plant to select the most economical processing methods. (auth)

33765 LWR FUEL RECOVERY: PROSPECTS, PLANS, AND PROBLEMS. Smith, C. Wesley; Bigge, William B. (General Electric Co., San Jose, Calif.). Nucl. News; 13: No. 7, 62-6 (Jul 1970).

Recovery of Pu and U from irradiated fuel elements is discussed. The Midwest Fuel Recovery Plant is described along with the Aquafluor process. Fuel recycle and transportation are considered. (M.C.G.)

33766 RAPID EXCHANGE OF METAL IONS ON METAL SULFIDE-CELLULOSE. Schuessler, Hans-Dieter; Herrmann, Guenter (Univ., Mainz). Radiochim. Acta; 13: 65-9(1970). (In German).

Ion or isotope exchange of metal ions with thin layers of metal sulfides in cellulose takes place even at high flow rates (about 1 ml/sec). The dependence of the exchange rate on quantity and contact time of the ion is shown in the following systems: Pd^{II}/CdS, Ag^{I}/CdS, Te^{VI}/CdS, Pd^{II}/PdS, and Ag^{I}/Ag_2S. The separation of 16 fission product elements, mainly such sulfide formers, is examined with layers of Ag_2S, CdS, and As_2S_3 in cellulose in the pH-range from 1 to 11. (auth)

33767 RAPID SEPARATION OF RADIOSTRONTIUM FROM FISSION PRODUCT SOLUTIONS. Stoeppler, Markus (Kernforschungsanlage, Juelich, Ger.). Z. Anal. Chem.; 250: 237-40(1970). (In German).

Aliquots of aged fission product solutions were passed down small ion-exchange columns of Dowex 2X8 (OH) and eluted with about 4 ml of water. The fission products except strontium, barium, and cesium remain on the column. Barium is then separated with chromate, and cesium by precipitating strontium carbonate. Strontium-89 and strontium-90 are simultaneously counted after dissolution of the strontium carbonate precipitate and a scavenging step with iron (III) hydroxide. After some days of growth ^{90}Y is separated and counted. Yield determinations are carried out by complexometric titration. (auth)

33768 SEPARATION OF VERY CLOSELY RELATED ELEMENTS BY PRECIPITATION AND SIMULTANEOUS DECOMPLEXATION ACCOMPANIED BY EXCHANGE AND DISPLACEMENT REACTIONS. Pajakoff, Sw. (Technische Hochschule, Vienna). Monatsh. Chem.; 100: 290-4(Jan-Feb 1969). (In German).

Rare earth ions were found to be released from their EDTA complexes at arbitrary rates in a coupled dissociation —association reaction with Co, Cu, and Ni salts, respectively. In the presence of precipitating agents the rare earth ions are selectively precipitated in homogeneous media. Highly effective separations, preparation of ultra-pure samples of the cerite metals and the preparation of pure samples of Pr and Nd are described. (auth)

33769 PAPER CHROMATOGRAPHIC CRYSTALLIZATION, A METHOD FOR THE PREPARATION OF COMPLEX COMPOUNDS AND FOR THE PURIFICATION OF RARE ELEMENTS. I. Pajakoff, Sw. (Technische Hochschule, Vienna). Monatsh. Chem.; 100: 280-9(Jan-Feb 1969). (In German).

With the help of a paper chromatographic crystallization technique it is possible to determine optimum crystallization conditions of the badly crystallizing oxalato complexes of Al, Ga, In, Cr, Fe, Zr, Hf, Nb, Ta, Ti, and Ge and to remove quantitatively their crystallization inhibiting oxo and hydroxo complexes. The different migration rates and the behavior of the oxalates and oxalato complexes of the impurities as well as the distribution, adsorption, and ion exchange phenomena operative in paper chromatographic crystallization may be used for ultra-purification of some rare elements by means of their oxalates and oxalato complexes, for instance for Ge, Zr, Nb, Sc, U, In, and others. The distribution of impurities in paper chromatographic crystallization follows a complicated mechanism and is not explainable on the basis of adsorption or mechanical interaction of mother liquors alone. (tr-auth)

33770 JAERI'S REPROCESSING TEST PROJECT. 3. THE CIRCUMSTANCE OF THE DOMESTIC EXTRACTION OF PLUTONIUM IN JAPAN. Aochi, Tetsuo (Japan Atomic Energy Research Inst., Tokai). Genshiryoku Kogyo; 16: No. 1, 81-4(Jan 1970). (In Japanese).

A fuel reprocessing test facility using TBP extraction followed by ion-exchange in JAERI is described. Following an accidental chemical explosion, the study of safety measures, and the design and construction of solvent recovery and Pu refining and concentration facilities were carried out. These two facilities are described. The operation test of the extraction-separation system, and then, the first cold test were carried out. The expansion, preparation, and test of a hot lab analytical facility are described. For the liquid waste treatment facility, the underlying principle is the use of the existing facilities in JAERI to the fullest extent, the temporary storage of wastes, which can not be treated in the existing facilities, etc. (NSA of Japan)

33771 STUDIES ON ION-EXCHANGE EQUILIBRIA FOR CESIUM-HYDROGEN SYSTEM. Hagiwara, Zenzi (Tohoku Univ., Sendai); Shinada, Yutaka. J. Nucl. Sci. Technol. (Tokyo); 7: 219-26(May 1970).

Ion-exchange equilibrium between Cs and H on a sulfonated polystyrene resin of Dowex 50W with 8% crosslinking was studied over a temperature range of 25 to 60°C, using ^{137}Cs as radioactive tracer; the various experimental data related to the equilibrium experiments were examined in detail by several different methods; a new treatment to take into account the water uptake in the exchange system Cs-H was also applied with the aid of a radioactive tracer technique. The thermodyamic equilibrium constant K_H^{Cs} determined by the present study compares well with the values calculated indirectly from experimental data found by other investigators. Data are also given for the heats, free energies, and entropies of the exchange reaction involving Dowex 50W. Fairly good results were obtained on the exchange of Cs and H. (auth)

33772 ORGANIC SOLVENT EXTRACTION OF NIOBIUM FROM SULPHURIC SOLUTIONS. Dragulescu, C.; Kyri, I. Bul. Stiint. Teh. Inst. Politeh. Timisoara; 13: 303-12(Jul-Dec 1968). (In Rumanian).

The extraction of Nb from sulfuric acid solutions with acetylacetone, benzene, chloroform, and butanol was investigated. The

influences of metal concentration, sulfuric acid concentration, KSCN concentration, pH, and composition of the organic phase were evaluated. Niobium could be extracted in the presence of KSCN with acetylacetone and with mixtures of acetylacetone with other solvents. (tr-auth)

33773 JAERI'S REPROCESSING TEST PROJECT. 4. THE CIRCUMSTANCE OF THE DOMESTIC EXTRACTION OF PLUTONIUM IN JAPAN. Aochi, Tetsuo (Japan Atomic Energy Research Inst., Tokai). Genshiryoku Kogyo; 16: No. 2, 53-7(Feb 1970). (In Japanese).

A fuel reprocessing test facility using TBP extraction followed by ion exchange in JAERI is described. On completion of alteration of the facilities their performance was tested, and various defects revealed. The alteration and other improvement made subsequently to fuel transport mechanism, dissolving tank and off-gas system, extraction and separation system, etc., are described. Shielding, including those for penetrations and openings, is described. The experimental test facility, consisting of dissolving tank, mixer-settlers, and ion-exchange towers, is explained. The second cold test, including dissolution-extraction-separation, aluminum dissolution, uranium dissolution, and finally the treatment of JRR-3 simulating fuel is described. (NSA of Japan)

33774 TECHNIQUE FOR REMOVING RADIOACTIVE ELEMENTS OF GROUP VIII OF THE PERIODIC TABLE. Kepak, F. Czechoslovakian Patent 131,067. 27 Nov 1968. Filed 19 May 1966.

A method is described for removing radioactive elements of the VIIIth group of the periodic table from aqueous solutions by adsorption using hydrated ferric oxide with an admixture of 0.1 to 5% of silver in the form of silver oxide. (NSA of Czech.)

33775 SEPARATION AND DETERMINATION OF ^{95}Zr–^{95}Nb AND ^{106}Ru IN PROCESS SOLUTIONS ON REPROCESSING TESTS WITH IRRADIATED FUELS. Hashitani, Hiroshi; Emura, Satoru; Katsuyama, Kazuo; Nakajima, Katsutoshi (Japan Atomic Energy Research Inst., Tokyo). Nippon Genshiryoku Gakkaishi; 12: 259-63(1970). (In Japanese).

With use made of the oxine extraction methods previously reported, the authors separated and determined ^{95}Zr–^{95}Nb and ^{106}Ru present in the process solutions resulting from reprocessing tests on irradiated fuels from the JRR-3 in the Japan Atomic Energy Research Institute. The procedures were simplified to facilitate handling of the highly radioactive samples in the shielded cell. The ^{95}Zr–^{95}Nb were extracted with 10 ml of chloroform as oxinates at pH 4.5 ~ 5.5 in the presence of acetate and sulfite, and the extract was washed with a potassium chloride solution of pH 2. The ^{106}Ru, which had been adjusted to a valency of 6, was extracted as oxinate at pH 4.5 ~ 6.0. The extract was washed with sulfuric acid (1 + 1). Recovery of the nuclides was approximately 90% in each case, and the separated nuclides were radiochemically pure. The γ activities of the nuclides were measured, and the decontamination factors of the nuclides in the process were determined. (auth)

33776 SEPARATION OF LANTHANIDES BY CHROMATOGRAPHY ON ION-EXCHANGE PAPER SA-2 IN α-HYDROXYISOBUTYRATE MEDIUM. Fenyo, J. C. (Faculte des Sciences, Rouen, France); Selegny, E.; Gusmini, S.; Dubuquoy, C. J. Chromatogr.; 49: 269-77(3 Jun 1970). (In French).

Quick separation of the rare earths La, Ce, Pr, Nd, Pm, Sm, Eu, and Y was accomplished by chromatography on strongly acidic ion-exchange paper (SA-2) with ammonium α-hydroxyisobutyrate as the eluent. Calculations on complex formation indicated that the most selective distribution factor between these metals was obtained when using 0.24 M α-hydroxyisobutyrate at pH 5.0. These conclusions were confirmed experimentally. The optimal operation conditions are discussed and illustrative examples of the separation of rare earths from fission products are provided. The technique can be used for even a few tenths of micrograms of each element. (auth)

33777 SEPARATION OF TRANSURANIUM ELEMENTS BY GAS CHROMATOGRAPHY OF THEIR CHLORIDES. Svarova, T. S.; Zvara, I. (Joint Inst. for Nuclear Research, Dubna, USSR). J. Chromatogr.; 49: 290-2(3 Jun 1970).

Pa, U, Np, Pu, Am, and Cm were separated by a gas chromatographic method previously reported for separation of the lanthanide elements. Aluminum trichloride is used as a component of the carrier gas. Gaseous chloride complexes are synthesized at the moment of their introduction into the column. The method is especially effective for the separation of Am–Cm. (J.G.B.)

33778 STRIPPING OF PLUTONIUM FROM TRILAURYLAMINE NITRATE SOLUTIONS. Souka, N. (Atomic Energy Establishment, Cairo). Radiochim. Acta; 13: 71-3(1970).

The possibility of using formic acid as a stripping agent for plutonium from trilaurylamine nitrate solutions was studied and discussed. (auth)

33779 SEPARATION OF ^{99}Mo FROM FISSION PRODUCTS. Brigevich, R. F.; Kuznetsov, R. A. Radiokhimiya; 12: 413-14 (1970). (In Russian).

An attempt was made to separate radiochemically pure ^{99}Mo with about 100% yield and a small amount of inactive carrier (100 to 200 μg Mo) using natural uranium as a threshold detector and a special radiochemical method. The small amount of carrier permitted the use of a $4\pi\beta$ counter for measuring absolute activity of ^{99}Mo. The activity of the preparation was measured after establishing ^{99}Mo–^{99m}Tc equilibrium. The chemical yield of ^{99}Mo was equal to 98.6 ± 7%. (R.V.J.)

EARTH SCIENCES

Geology and Hydrology

33780 (UCRL-50830) T-WAVE: A COMPUTER CODE FOR ANALYZING THE NONSTEADY GRAVITY DECAY OF A GROUNDWATER ANOMALY. Korver, John A. (California Univ., Livermore. Lawrence Radiation Lab.). 16 Mar 1970. 59p. Dep. CFSTI.

The T-WAVE Code is based on a one-dimensional numerical model describing the gravity decay of a groundwater mound. The Fortran program for the T-WAVE Code may be used to examine the time-dependent flow characteristics of anomalous groundwater mounds resulting from underground nuclear explosions near or below the regional water table. The code allows the permeability and/or porosity to be in either a cylindrical or spherical geometry surrounding the shot point, and it also allows for internal horizontal or vertical discontinuities of the permeability or porosity. It is also possible to follow the horizontal displacement of ideally tagged water particles as a function of time. (auth)

33781 (UCRL-50854) HYDROLOGIC DATA REDUCTION TECHNIQUES AND UNIT CONVERSIONS FOR USE IN THE OGRE, T-WAVE, FLIP, AND RAVE FLUID FLOW CODES. Korver, John A. (California Univ., Livermore. Lawrence Radiation Lab.). 13 Mar 1970. 8p. Dep. CFSTI.

Methods used to determine kH, the permeability-thickness product for a given location, from hydrologic test data are described, and methods for converting the units of permeability to the correct dimensional form for use in specific computer codes for analyzing ground water flow are presented. (L.C.L.)

33782 SELECTIVE $\gamma-\gamma$ METHODS IN ORE PROSPECTING DRILLING. Morvai, Laszlo. Magy. Geofiz.; 9: 105-12(1968). (In Hungarian).

Questions related to the application in ore prospecting drilling of the selective gamma-gamma well logging method using a plastic-cased probe with a ^{75}Se source are considered. The investigations were conducted for finding photoeffects, i.e., for observation of changes of concentration of heavy elements. The possibility of using neutron-activation analysis for locating copper ores is discussed. Problems related to interpretation of the data obtained are described, and directions of further investigations are outlined. (tr-auth)

33783 HOMOGENIZED FISSION TRACK ANALYSIS OF URANIUM IN SOME ULTRAMAFIC ROCKS OF KNOWN POTASSIUM CONTENT. Fisher, David E. (Univ. of Miami, Fla.). Geochim. Cosmochim. Acta; 34: 630-4(May 1970).

New data on the U contents of a diverse suite of ultramafic rocks are presented. The K/U ratio is equal to or less than the crustal ratio, in disagreement with the concept of a chondritic earth. (auth) (UK)

33784 XENON IN NATURAL GASES. Bennett, G. A.; Manuel, O. K. (Univ. of Missouri, Rolla). Geochim. Cosmochim. Acta; 34: 593-610(May 1970).

Analyses of noble gases from four natural gases reveal radiogenic ^4He and ^{40}Ar, excess ^{21}Ne and ^{38}Ar from α-induced reactions and an excess of the β-unshielded xenon isotopes with an abundance pattern unlike that from the spontaneous fission of ^{238}U. The pattern of excess ^{129}Xe, ^{131}Xe, ^{132}Xe, ^{134}Xe, and ^{136}Xe in these gas samples is such that a mixture of this xenon with the primordial xenon in meteorites could produce the abundance pattern of atmospheric xenon for all isotopes heavier than ^{128}Xe. It is suggested that this strange fission-yield pattern is the result of a mechanism suggested earlier by Cameron (the addition of β-shielded xenon isotopes to the atmosphere by the solar wind). By modifying Cameron's hypothesis so that solar-wind xenon contains excess ^{124}Xe and ^{126}Xe in addition to ^{129}Xe and ^{130}Xe, the addition of this solar wind xenon to atmospheric and meteoritic xenon can account for the general isotopic anomaly pattern observed across meteoritic xenon, the very low fission yields of ^{131}Xe and ^{132}Xe reported in xenon-rich meteorites and the high fission yields of ^{131}Xe and ^{132}Xe which have been calculated for xenon in gas wells and in the earth's atmosphere. (auth) (UK)

33785 DISEQUILIBRIUM OF THE ^{234}U SERIES IN RECENT VOLCANIC ROCKS. Nishimura, Susumu (Univ. of Osaka). Earth Planet. Sci. Lett.; 8: 293-300(May 1970).

Concentrations of ^{238}U, ^{230}Th and ^{226}Ra are given for recent volcanic rocks from various regions. Disequilibrium observed among ^{238}U series is interpreted in terms of chemical fractionations occurring during magmatic processes. The fractionation pattern, Ra $\leq$ Th > U is observed in Hawaii, the Azores and Japan in oceanic and island arc volcanic regions, and Th < U, in the Caucasus, Kamchatka and Italy for continental volcanic regions. (auth)

33786 HEAT FLOW AND RADIOACTIVITY IN AUSTRALIA. Jaeger, J. C. (Australian National Univ., Canberra). Earth Planet. Sci. Lett.; 8: 285-92(May 1970).

Heat flow and surface radioactivity have been measured in four drilled holes in the Western Australian shield. Measured heat flows Q range from 0.69 to 1.28 $\mu cal/cm^2$ sec and surface heat generation A from 1.4 to 21.9×10^{-13} cal/cm^3 sec. Despite large fluctuations in radioactivity, there is good agreement between mean values from surface samples and samples from the holes. Three of the values fit a straight line $Q = a + bA$ with $a = 0.63$ and it is suggested that the high value of A at the fourth point is anomalous. The relationship of previous measurements in greenstones to the present values is discussed. A brief review of other measurements of heat flow and radioactivity in Australia is given. (auth)

33787 FALLOUT AND CLIMATE STUDIES ON FIRN CORES FROM CARREFOUR, GREENLAND. Ambach, W. (Univ., Innsbruck); Dansgaard, W. Earth Planet. Sci. Lett.; 8: 311-16 (May 1970).

Studies were conducted to compare detailed vertical gross β-activity and tritium profiles in a high polar glacier with a temporal record of fallout of fission products at high latitudes, to compare the annual net accumulation data that might be derived from the radioactivity and stable isotope profiles, and to estimate the recent climatic development on the Mid Greenland ice sheet. Two snow and firn cores were drilled on the Greenland ice sheet, and were cut into 10 to 15 cm long segments for analysis. The longer core, representing a 20 m depth, was analyzed for gross β-activity and oxygen isotope ratios. The shorter core, reaching from 1 to 10 m deep, was analyzed for ^3H and oxygen isotopes. For the deeper core it was concluded that none of the β-activity and ^{18}O profiles is sufficient for establishing a reliable isotopic identification of recent annual snow layers in that area. However, such identification can be obtained in the period 1953 to 1965 by comparing the two profiles mentioned or by comparing the β-activity profile with exactly dated fallout data from nearby stations. The use of the β-activity measurements is limited to strata formed since 1953. The tritium profile obtained indicates seasonal variation in the tritium fallout clearly enough for identification of annual layers back to the beginning of the nuclear bomb tests in 1953. Before 1953, the tritium fallout was of natural origin with minor seasonal variation. (L.C.L.)

33788 GEOCHEMISTRY AND GEOLOGY OF HELIUM. Esfandiari, Bijan. Norman, Okla.; Univ. of Oklahoma (1969). 148p.

Thesis.

Helium is generated by the alpha decay of radioactive nuclides in certain rocks and minerals. Concentration of uranium, which is an alpha emitter, in all the rock types was determined using the gamma ray spectroscopy technique and a 400-Channel Pulse Height Analyzer. This concentration was a measure of helium generating potential due to the uranium content of the specimens examined for gamma radiation. Considering thorium to uranium ratio of 3 to 1, it is suggested that the amount of helium derived from uranium is equal in amount to that generated by thorium. Other alpha emitters such as radium and polonium were not considered because of their extremely low abundances in terrestrial material. It was concluded that the sedimentary rocks, as well as igneous and metamorphic rocks, are potential helium producers. In addition to major rock types, certain fluids have the ability to dissolve or leach uranium from rocks. These fluids will become alpha emitters after carrying away the radioactive minerals in the rocks. Therefore, there must be a definite relationship between the composition of mobile ground waters and their content of radioelements. Concentration of the radioelements such as uranium and thorium in fluids is affected by such factors as salinity, temperature, and pressure. It was found that fluids such as brines and petroleum have the ability to transfer uranium from their original sites. Since the brines and petroleum which are found in rocks today have migrated into their present position, it can be concluded that later migration will partially carry away radioelements like uranium and thorium. Upon entrapment of these alpha emitting fluids, the helium generated by the alpha particles escapes from the solution due to the very insoluble nature of this

gas. Natural gas analyses indicated that there was a good correlation between radiogenic argon and helium. Also, the nitrogen content generally increased with increasing helium content, but this was not always the case. It is concluded that the variable helium content in natural gases is a function of several complex factors and the interaction which takes place among those factors. To name a few of them one could mention the local radioactivity in host rocks, the alpha emitters, preferential retention and diffusion, leakage, solubility, porosity of the host rocks, and the environment containing the host rock. (Diss. Abstr. Int., B) (auth)

Meteorology

Refer also to abstracts 33914, 34208, 34210, 34219, and 34322.

33789 (LF-41, pp 61-9) A NEW METHOD FOR THE GENERATION OF AEROSOLS OF INSOLUBLE PARTICLES FOR USE IN INHALATION STUDIES. Kanapilly, G. M.; Raabe, O. G.; Newton, G. J. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.).

A method has been developed for the controlled generation of aerosols of spherical particles of insoluble metal oxides. This method consists of (a) nebulizing of a solution (or suspension) of the chosen metal, (b) drying the droplets, (c) passing the aerosol through a high temperature heating column to produce the spherical oxide particles, and (d) cooling the aerosol with the addition of diluting air. This procedure provides a continuous source of insoluble aerosols, the size distribution of which depends upon the distribution of the droplets from the nebulizer used. Employing the Fulwyler droplet generator, this technique has been used to produce monodisperse aerosols. The physical and chemical nature of aerosols of zirconium and of lanthanum compounds generated by this method have been studied in detail. The physical characteristics have been ascertained by electron microscopic observations, particle density measurements, and aerodynamic samples. Tracer and instrumental techniques have been used to identify chemical properties. (auth)

33790 (LF-41, pp 70-4) MEASUREMENT OF AEROSOL PARTICLE DENSITY WITH THE MILLIKAN APPARATUS. Raabe, O. G. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.).

The Millikan "oil-drop" apparatus has been used to measure the size and density of several types of spherical aerosol particles by observing their falling speed with no electric field and measuring the balancing potentials for various conditions of electrical charge. This method worked well for particles from 0.7 μ to 3.0μ in diameter. The types of particles studied included polystyrene latex, polyvinyltoluene, uranine, cesium chloride and fused clay. After measurement it was sometimes possible to collect the particle on an electron microscope grid for microscopic examination. This allowed direct comparison of the apparent physical diameter and the calculated value. (auth)

33791 DATA. SECTION IV. OTHER DATA. Radiol. Health Data Rep.; 11: 37-45(Jan 1970).

The results of routine sampling of biological materials and other media are reported. Included are environmental monitoring data for the Dravosburg, Penn., site of the Bettis Atomic Power Laboratory during 1968, for the St. Petersburg, Fla., site of the Neutron Devices Dept. during July through Dec. 1968, and for the Oak Ridge, Tenn., area during July through Dec. 1968. Also included are data on nuclear detonations which occurred during Dec. 1969. (L.C.L.)

33792 DATA. SECTION III. AIR AND DEPOSITION. Radiol. Health Data Rep.; 11: 29-36(Jan 1970).

Sept. 1969 measurements of gross β-activity in surface air and precipitation at 73 stations in the USA and at 24 stations in Canada, and in surface air only at 12 stations in South America are presented. March and April 1969 measurements of gross β-activity in surface air at 16 stations in Mexico are reported. (L.C.L.)

33793 TENTATIVE METHOD OF ANALYSIS FOR GROSS ALPHA RADIOACTIVITY CONTENT OF THE ATMOSPHERE. Shleien, B.; Heatherton, R. G.; Hildebrandt, P. F.; Lockhart, L. B. Jr.; Morse, R. S.; Stein, W.; Van Farowe, D. F.; Hull, A. Health Lab. Sci.; 7: Suppl., 102-4(Jan 1970).

A method for determining the gross α activity in the atmosphere is described. The equipment required includes an air mover, air flow meter, particulate filter, detector, and an α counter. The procedure is described. It is concluded that while information on the specific radioisotopes present in the atmosphere cannot be obtained by this method, it is a simple, rapid, and inexpensive procedure for establishing the gross concentration of α emitters in the ambient air. (L.C.L.)

33794 DATA. SECTION IV. OTHER DATA. Radiol. Health Data Rep.; 11: 165-77(Mar 1970).

Data from routine samplings of biological materials and other media are reported. The methods used for postshot off-site surveillance around the Nevada Test Site during July through Dec. 1965 and for Amchitka Island during Oct. and Nov. 1965 are described. The results showed that no individual in either area received an unsafe exposure as a result of the nuclear tests. Measurements during Jan. through March 1969 of the ^{90}Sr content in human bones from throughout the US are described and the results tabulated. Environmental monitoring data taken during Jan. to July 1969 at the Atomics International site in California and at the Feed Materials Production Center Site in Ohio are presented. Nuclear detonations which occurred in the US during February 1970 are reported. (L.C.L.)

33795 DATA. SECTION III. AIR AND DEPOSITION. Radiol. Health Data Rep.; 11: 157-64(Mar 1970).

Nov. 1969 measurements of gross β-activity in surface air and precipitation at 73 stations in the USA and 24 stations in Canada, and in surface air only at 12 stations in South America are presented. July and Aug. measurements of gross β-activity in surface air at 16 stations in Mexico are reported. (L.C.L.)

33796 STRONTIUM AND PLUTONIUM ISOTOPES IN GROUND LEVEL AIR, OCTOBER 1963-MARCH 1969. Shleien, B.; Cochran, J. A.; Magno, P. J. (Bureau of Radiological Health, Winchester, Mass.). Radiol. Health Data Rep.; 11: 129-34(Mar 1970).

Data are presented on monthly concentrations of strontium-90, strontium-89, plutonium-239, and plutonium-238 in ground level airborne particulates collected at Winchester, Mass., from October 1963 (for radionuclides of strontium) and May 1965 (for radionuclides of plutonium) to March 1969. The ratio of strontium-89 to strontium-90 in these samples indicates an influx of strontium-90 following all but the sixth atmospheric detonation on the Chinese mainland. It is estimated that in 1968 approximately 60 percent of the strontium-90 present in ground level air was of post-1963 origin. The ratio of plutonium-239 to strontium-90 prior to February 1968 was 0.17 ± 0.009. There was a gradual increase in this ratio later in 1968 which is attributed to debris following the sixth, seventh, and eighth tests on the Chinese mainland. Levels of plutonium-238 in SNAP-9A debris in ground level air are somewhat lower than had been predicted. (auth)

33797 TRITIUM CONCENTRATION IN PRECIPITATION, 1967-1968. Moghissi, A. A.; Porter, C. R. (Southeastern Radiological Health Lab., Montgomery, Ala.). Radiol. Health Data Rep.; 11: 137-40(Mar 1970).

Since 1967 the tritium content of atmospheric precipiation at 8 stations in the continental US and in Alaska and Hawaii has been measured. The measurement method is described, and results for 1967 and 1968 are tabulated and plotted. Both years showed a peak of tritium activity in April. (L.C.L.)

33798 DETERMINATION OF ^{210}Pb MEAN RESIDENCE TIME IN THE ATMOSPHERE. Francis, Chester W.; Chesters, Gordon; Haskin, Larry A. (Univ. of Wisconsin, Madison). Environ. Sci. Technol.; 4: 586-9(Jul 1970).

Rainwater was filtered through a 0.22-μ Millipore filter before radioassay of the resulting dust and filtrate fractions for ^{210}Po. Lead-210 contents of the fractions were obtained by following the growth of ^{210}Po activity in stored samples as a function of time. At the time of rainfall, the ^{210}Po contents of the dust and filtrate fractions were approximately equal, but the dust fractions contained less than 3% of the total ^{210}Pb. Polonium-210 and ^{210}Pb in the dust fractions were already in radioactive equilibrium at the time of the rainfall suggesting that their presence in the dust was not a result of recent scavenging of ^{210}Pb from the troposphere. Ratios of ^{210}Pb to ^{210}Po used for calculations of mean atmospheric residence time for ^{210}Pb should, therefore, be those of the filtrate. From those ratios, a mean atmospheric residence time for ^{210}Pb of 9.6 days, ±20%, is obtained. (auth)

33799 ^{90}Sr, ^{89}Sr, ^{239}Pu, AND ^{238}Pu CONCENTRATIONS IN GROUND-LEVEL AIR, 1964-1969. Shleien, Bernard; Cochran, Joseph A.; Magno, Paul J. (Bureau of Radiological Health, Winchester, Mass.). Environ. Sci. Technol.; 4: 598-602(Jul 1970).

Data are presented on monthly concentrations of strontium-90, strontium-89, plutonium-239, and plutonium-238 in ground-level airborne particulates collected in Winchester, Mass., from October 1963 (for radionuclides of strontium) and May 1965 (for radionuclides of plutonium) to March 1969. The ratio of the activities of strontium-89 to strontium-90 in these samples indicated an influx of strontium-90 following all but the sixth Chinese atmospheric detonation. In 1968, approximately 60% of the strontium-90 present in ground-level air was of post-1963 orgin. The ratio

of the activities of plutonium-239 to strontium-90 prior to February 1968 was 0.017 ± 0.009. There was a gradual increase in the above ratio later in 1968 which is attributed to debris from the sixth, seventh, and eighth Chinese tests. Levels of plutonium-238 in SNAP-9A debris in ground-level air during 1968 were 80% to 50% lower than had been predicted. (auth)

33800 DATA. SECTION III. AIR AND DEPOSITION. Radiol. Health Data Rep.; 11: 85-93(Feb 1970).

Oct. 1969 measurements of gross β-activity in surface air and precipitation at 73 stations in the USA and at 24 stations in Canada, and in surface air only at 12 stations in South America are presented. May and June 1969 measurements of gross β-activity in surface air at 16 stations in Mexico are reported. The July to Sept. 1968 measurements of the ^{238}Pu and ^{239}Pu content in fallout and atmospheric precipitation at 11 stations in the USA are tabulated. (L.C.L.)

33801 DATA. SECTION IV. OTHER DATA. Radiol. Health Data Rep.; 11: 95-105(Feb 1970).

The results of routine environmental monitoring programs are presented. Included are environmental monitoring data for the Illinois site of the Argonne National Laboratory during July through Dec. 1968 and for the Colorado site of the Rocky Flats Plant during Jan. to July 1969. A report on the May 11, 1969 fire at the Rocky Flats Plant is presented. Nuclear detonations which occurred in the US and USSR during Jan. 1970 are mentioned. (L.C.L.)

Mineralogy and Exploration

33802 (AEC-tr-7152) ARLETTE URANIUM DEPOSIT IN ARLIT REGION, REPUBLIC OF NIGER. Baudet, J.; Bizard, Ch. A Translation. 20p. Dep. CFSTI.

The distribution and formation of the Arlette uranium deposit in the Republic of Niger are described using information from initial core drillings. (L.C.L.)

33803 (CONF-660967-2) URANIUM MINERALIZATIONS OF THE ITALIAN ALPS. Mittempergher, Mario. Translated from pp 319-33 of International Symposium on Mineral Deposits in the Alps, Trento-Mendola, Italy, 11-18 September 1966. 29p. Dep. CFSTI.

The uranium mineralizations of the Italian Alps are described in terms of location, distribution, geology of the containing media, and age of formation. These mineralizations were found in all geographical sectors of the Alps. (L.C.L.)

33804 URANIUM AND THORIUM OCCURRENCES ON THE NORTH SHORE OF THE GULF OF ST. LAWRENCE. Baldwin, A. B. (Cerro Mining Co., Toronto). CIM (Can. Mining Met.) Bull.; 63: 699-707(Jun 1970).

Uranium and thorium mineralization occurs at several localities in eastern Quebec along the north shore of the Gulf of St Lawrence. The main occurrences are near Sept-Iles, Baie Johan Beetz, Romaine and St-Augustin Rivers. Mineralization occurs mainly as disseminated uraninite, uranothorite, uranothorianite, monazite, and minor zircon and allanite. Yellow to orange oxidation products are observed along fracture planes of the uranium-bearing deposits to a depth of a few feet. Magnetite, biotite and smoky quartz have a distinct tendency to accompany the radioactive minerals. The host rocks include white to pink pegmatite, pink granite and also, in the case of the Romaine and St-Augustin Rivers occurrences, cream to grey plagioclase-rich, well foliated paragneiss and migmatite. Radioactivity near secondary structures, such as fractures and joint planes, indicates some reconstitution of radioactive minerals. The North Shore of Quebec is the northeast extension of the Grenville sub-province. It is also a uranium-thorium metallogenic province. (auth) (Canada)

Oceanography

33805 (RLO-2091-6) RADIOCARBON IN THE SEA. Progress Report, May 1, 1969-May 1, 1970. Fairhall, A. W. (Washington Univ., Seattle. Dept. of Chemistry). Contract AT(45-1)-2091. 34p. Dep. CFSTI.

Oceanographic studies of the content and distribution of ^{14}C in seawater from world-wide sampling stations were conducted to determine the effect of bomb-produced ^{14}C in the atmosphere on the ^{14}C content in the sea, to determine the natural ^{14}C levels in seawater so that bomb-^{14}C perturbations can be recognized, and to investigate mixing processes in the deep sea using ^{14}C as a tracer. The experimental equipment and procedures are described, and the results to date for several sampling stations are presented as ^{14}C profiles as a function of ocean depth. (L.C.L.)

33806 DISTRIBUTION OF COBALT IN OCEANIC WATERS. Robertson, D. E. (Battelle-Northwest, Richland, Wash.). Contract AT(45-1)-1830. Geochim. Cosmochim. Acta; 34: 553-67 (May 1970).

Neutron activation and direct instrumental analysis utilizing multi-dimensional gamma-ray spectrometry were employed to measure the concentrations and variations of cobalt in oceanic waters. The cobalt concentrations observed in this work are much lower than most previously reported values. Surface concentrations in the North Central Pacific Ocean averaged about 10 nanograms/liter. Tropical Northeast Pacific Ocean waters and Oregon coastal waters averaged about 20 and 46 ng Co/l, respectively, after a few high values suspected of contamination were omitted. Tropical North Atlantic Ocean waters averaged approximately 25 ng Co/l, while Bering Sea and Mediterranean Sea waters averaged approximately 30 and 20 ng Co/l, respectively. Various coastal areas throughout the world contained slightly higher concentrations. The distribution of cobalt in the oceans is highly variable. Calculations show that assimilation of cobalt by phytoplankton and marine organisms cannot fully account for the observed variations, and the heterogeneous distribution of cobalt throughout the oceans is, for the most part, inexplicable. (auth) (UK)

Seismology

Refer also to abstract 33813.

33807 (AD-703295) SPHERICAL WAVES IN INELASTIC MATERIALS. Isenberg, J.; Bhaumik, A. K.; Wong, F. S. (Agbabian-Jacobsen Associates, Los Angeles, Calif.). Mar 1970. Contract DASA01-68-C-0081. 62p. (DASA-2404). CFSTI.

The effects of constitutive properties on spherical wave propagation are investigated through finite element calculations of an infinite medium (Cedar City Tonalite) loaded internally by a sphere of chemical explosive. Detonation of the explosive is represented by applying a pressure to the cavity surface which varies with time in a manner similar to that measured experimentally by Physics International Company. Results are presented as stress/time histories and stress strain relations at various cavity radii and as rates of attenuation of the peak radial stress. The results illustrate the effect of varying the bulk modulus, yield criterion and plastic flow rule. (auth)

33808 (NVO-1163-204) SEISMIC RESPONSE CHARACTERISTICS AT TONOPAH, NEVADA FROM UNDERGROUND NUCLEAR DETONATIONS. Williams, Spencer L.; Davis, Lawrence L.; Spiker, C. T.; West, Lewis R. (Environmental Research Corp., Alexandria, Va.). May 1970. Contract AT(29-2)-1163. 121p. Dep. CFSTI.

The seismic response of Tonopah, Nevada, is defined by analyzing seismic data observed from underground nuclear detonations at the Nevada Test Site (NTS) and one (Faultless) detonated at the Central Nevada Test Area (CNTA). The response at Tonopah varies with the location of the detonation. Pahute Mesa and CNTA detonations produce seismic signals richer in high frequency energy than would be expected on the basis of NTS average experience. This results in peak acceleration amplitudes being considerably higher than normal. Yucca Flat detonations produce more nearly normal response at Tonopah. Ground motions observed at a number of Tonopah sites instrumented for the Clarksmobile detonation (Yucca Flat) confirm that the seismic response at two sites, Tonopah Motel (alluvium), and Tonopah Church (hardrock), which have been instrumented for many detonations, are representative of average response in the Tonopah area. Differences in the spectra for the Church and Motel sites are explained by the frequency-dependent amplification caused by a thin layer of unconsolidated material at the Motel site. Time windows for body (P and S) waves and surface waves are identified to illustrate the nature of seismic signals received in Tonopah. The geologic conditions at the source and at Tonopah are described and, to the extent possible, are correlated with observed response. Refined prediction procedures are presented with which to predict peak vector amplitudes and PSRV spectra at Tonopah sites. These procedures are based on results obtained from recent detonations, in conjunction with past Nevada Test Site experience. Recommendations to isolate the cause of the anomalous seismic response at Tonopah are discussed. (auth)

33809 SHORT-PERIOD P-CODA CHARACTERISTICS IN THE EASTERN CANADIAN SHIELD. Hasegawa, H. S. (Do-

minion Observatory, Ottawa). Bull. Seismol. Soc. Amer.; 60: 839-58(Jun 1970).

The short-period P-coda of eight earthquake events (recorded on magnetic tape) and one underground nuclear event (standard Canadian network seismogram) are analyzed in both the time and frequency domains in order to determine the transmission characteristics of the crust in the eastern section of the Canadian Shield. Surface particle motion diagrams indicate that there is appreciable anomalous P-S conversion in this region, starting at the base of the Labrador trough and extending to the upper mantle. The spectral ratio test, when applied to short-period records, is found to be capable of resolving thin crustal layers only. Coherency studies of teleseismic events recorded over a lateral distance, the same order of magnitude as the thickness of the crust in this region, show that the coherency (0.5 average) is much lower for the horizontal component than for the vertical component and also does not appear to vary appreciably with epicentral distance, whereas the vertical component does. Since for many of the records the signal-to-noise ratio of the vertical and horizontal components is comparable, these results indicate the possibility of the horizontal transfer function being more unstable over this region than the vertical transfer function. From these observations it is concluded that (1) in the region of the eastern Canadian Shield where there is a surface layer of Proterozoic sediments about one km thick overlying basement rocks, the short-period body-wave transmission characteristics are more similar to those of the western Canada sedimentary basin in central Alberta than to those of the western part of the Canadian Shield near Yellowknife, Northwest Territories and (2) in order to resolve both thin and thick crustal layers by means of the spectral ratio test, both short- and long-period records of the P coda are required. (auth)

33810 ELASTIC WAVE PROPAGATION IN HETEROGENEOUS MEDIA. Beaudet, Paul R. (Environmental Research Corp., Alexandria, Va.). Contract AT(29-2)-1163. Bull. Seismol. Soc. Amer.; 60: 769-84(Jun 1970).

The wave equation is solved for the ensemble average of particle displacements produced by an explosion. The explosion is assumed to occur in a finite cavity in an infinite heterogeneous medium. The solution is applied to the seismic waves generated by an underground nuclear detonation. Field observations from the underground nuclear test program at the Nevada Test Site are in qualitative agreement with the theory. (auth)

33811 ANALYSIS OF GROUND MOTIONS AT SAN ONOFRE NUCLEAR GENERATING STATION APRIL 9, 1968. Housner, G. W.; West, P. J.; Johnson, C. G. (California Inst. of Tech., Pasadena, Southern California Edison Co., Camp Pendleton). Bull. Seismol. Soc. Amer.; 60: 987-1000(Jun 1970).

The Borrego Mountain earthquake of 9 April 1968 produced ground shaking having 5 percent g maximum acceleration at the 450 MW(e) San Onofre Nuclear Generating Station site. The recorded motion showed two distinct phases separated by about six seconds. The spectra of these phases differ markedly, presumably reflecting differences in source generation. There was no damage at the plant. More recently, a special seismic central accelerograph system has been installed to record the earthquake-induced motion of the concrete base of the containment structure and the response motion of the steam generators and pressurizer. Experience with the installation and operation of the expanded accelerograph system is reviewed with suggestions offered for alleviating problems due to system malfunction. (auth)

ENGINEERING

Nuclear Explosions

Refer also to abstracts 33780, 33796, 33808, and 33810.

33812 (LA-4346) DEVELOPMENT AND TESTING OF LEMP 1. Longley, H. J.; Longmire, C. L. (Los Alamos Scientific Lab., N. Mex.). 8 Dec 1969. Contract W-7405-eng-36. 28p. Dep. CFSTI.

LEMP 1 is a computer code for obtaining the solution, by finite difference methods, of Maxwell's equations in two space dimensions and retarded time, for the electromagnetic fields produced by a nuclear burst on the ground. The field components considered are B_φ, E_θ, and E_r in the usual spherical coordinates. These fields are calculated in the air, in the ground, and on the ground-air interface. In the ground the electrical conductivity is constant in time and space, and the source current is zero. The conductivity in the air is found by solving the "air-ion" equations, which take account of gamma-induced ionization, electron attachment to O_2, and electron-ion and ion-ion recombination. The source current in the air is the Compton recoil current produced by gamma rays, the source and transport of which are given by a fairly general and flexible prescription. The back-action of the fields on the air conductivity and the source current is treated. Two problems with known solutions are presented--a wave test problem and a diffusion test problem. The results of these problems show that the differencing scheme used, with the proper selection of the finite mesh, gives better than one percent accuracy in the calculated fields. Without using huge numbers of mesh points, the code gives fields whose accuracy is limited only by the source accuracy. (auth)

33813 (NVO-1163-209) ANALYSIS OF SEISMIC DATA, MILROW EVENT. Orphal, D. L.; Spiker, C. T.; West, L. R.; Wronski, M. D. (Environmental Research Corp., Alexandria, Va.). May 1970. Contract AT(29-2)-1163. 83p. Dep. CFSTI.

Peak resultant vector surface particle ground motions and pseudo-relative velocity (PSRV) spectra derived from nine seismograms recorded over a distance range of 7-377 km from Milrow, a calibration detonation on Amchitka Island, agree well with predictions for a 1,000 kt event, the approximate Milrow yield. Predictions of peak resultant vector ground motions and PSRV spectra were made on the basis of statistical analyses of ground motions recorded from numerous underground nuclear events at the Nevada Test Site (NTS). The agreement between the observed and predicted amplitude and frequency characteristics of the Milrow ground motions suggests that the effect of source, transmission path, and recording site parameters for Milrow is similar to that at the NTS for comparable detonations. Comparison of selected radial seismograms and PSRV spectra from Milrow with corresponding data recorded at comparable distances from Boxcar and Benham, two high-yield detonations on Pahute Mesa at the NTS, confirms this suggestion. The time-histories and spectral content of the Milrow ground motions are similar to those observed from Boxcar and Benham. The successful application of prediction methods based upon NTS experience to the Milrow event suggests that ground motions can be accurately predicted for underground nuclear detonations on Amchitka Island, a geologic environment similar to that found at the NTS. (auth)

33814 (SC-RR-69-1(Vol.1)) EJECTA FROM SINGLE-CHARGE CRATERING EXPLOSIONS. Carlson, Roland H.; Newell, Robert T. (Boeing Co., Albuquerque, N. Mex.). Jun 1970. Contract 59-1240. 195p. Dep. CFSTI.

For Sandia Labs., Albuquerque, N. Mex.

Eight high-explosive charges weighing 8 to 1000 pounds were detonated in playa. Each event included 24 to 40 locations of tracer material in the expected crater region. The objective was to obtain data relating the origin of crater ejecta to its depositional location. Resulting data are presented for craters, ejecta areal densities, crater and ejecta mass quantities, tracer dispersion, and an empirical prediction model. Apparent crater radius, depth, and volume scale as charge weight raised to the 0.35, 0.48, and 1.2 power respectively. These exponents are reduced when other crater data in playa are included in the analysis. The optimum scaled depth of burst of 1.5 ft/lb$^{\frac{1}{3}}$ for the 64-pound charge is not optimum for the 8- and 256-pound charges. Ejecta areal density for surface bursts is inversely proportional to radial distance to about the 2.7 power. At optimum burst depth this exponent varies from about 2.4 to 3.8, with the higher exponent associated with the largest charge. An areal density function in terms of scaled burst depth, radial distance, and charge weight is derived that compares favorably to the shots in this experiment. Regarding the proximity of ejected mass to the crater's edge, this experiment yields the same conclusions for burst depth and charge weight as do other cratering series in playa. For surface bursts, ejecta were deposited closer to the crater (on a scaled basis) as charge energy was increased. When burst depth was varied and charge weight held constant, ejecta were deposited closer to the crater (on a scaled basis) for greater burst depths. Tracer patterns exhibit a roughly normal dispersion. There was a predominance of counterclockwise skewness in centers of tracer mass. Tracer dispersion and range (to center of tracer mass) first increase and then decrease with tracer emplacement horizontal range, and decrease as tracer emplacement depth increases. Increasing tracer emplacement range and depth result in progressively deeper deposition of tracers in crater fallback, and tracer dispersion at any depth is directly proportional to the amount of tracer found at that depth. For charges of differing weight at the same scaled burst depth (near optimum), similar tracers were deposited closer to the crater on a scaled basis for the larger charge. (auth)

33815 (SC-RR-69-1(Vol.2)) EJECTA FROM SINGLE-CHARGE CRATERING EXPLOSIONS. VOLUME II. APPENDIX B. SUPPORTING DATA FOR VOLUME I. Carlson, Roland H.; Newell, Robert T. (Boeing Co., Albuquerque, N. Mex.). Jun 1970. Contract 59-1240. 127p. Dep. CFSTI.

For Sandia Labs., Albuquerque, N. Mex.

Two-hundred-fifty-two graphic representations of data on the dispersion of different tracers used to measure the displacement of ejecta from single-charge explosion-produced craters are presented. (L.C.L.)

33816 (SWRHL-64-r) OFF-SITE SURVEILLANCE ACTIVITIES OF THE SOUTHWESTERN RADIOLOGICAL HEALTH LABORATORY FROM JULY THROUGH DECEMBER 1967. (Public Health Service, Las Vegas, Nev. Southwestern Radiological Health Lab.). May 1970. 88p. Dep. CFSTI.

The Southwestern Radiological Health Laboratory of the Public Health Service performed off-site radiological surveillance for twelve announced events and one reactor experiment during the period from July through December 1967. This surveillance was conducted in the public areas surrounding the Nevada Test Site (NTS). Off-site radiological surveillance was provided for Project Gasbuggy, an underground gas stimulation project conducted in New Mexico on December 10, 1967. During the six-month period, one announced nuclear event, the Door Mist Event, and one experimental plan, EP-IIIA, of the NRX-A6 reactor test series released radioactivity which was detected off-site. Analysis of all sampling and surveillance information compiled during the six-month period indicates that the safety criteria established by the Atomic Energy Commission for the off-site population were not exceeded. (auth)

33817 (UCRL-Trans-10459) INTEGRATED STUDY OF BLAST-CRATER DIMENSIONS. Boulon, M.; Gautier, J. (Commissariat a l'Energie, Grenoble (France). Centre d'Etudes Nucleaires). Translated for Univ. of California Lawrence Radiation Lab., Livermore, from report CENG/ASP-Note-69-18. 45p. Dep. CFSTI.

The effects of various explosives, including nuclear explosives, fired in various soils and rocks, ranging from dry sand to basalt, were studied. A dimensional analysis was performed which enabled the experimental results related to blasts of all sizes, from a few grams of TNT to 100 kt, to be regrouped according to the characteristics of the soil and of the explosive. The method used for logically estimating the parameters which were not measured is explained. The correlations obtained are given in the form of two curves which show the apparent crater diameter and the apparent crater depth each as a function of the burst depth for a given charge. With these graphs it is possible to calculate the optimum dimensions of a crater when the medium and the explosive are specified. (L.C.L.)

33818 IDEAS FOR PEACEFUL NUCLEAR EXPLOSIONS IN USSR. Int. At. Energy Agency Bull.; 12: No. 2, 11-21 (1970).

Possible applications of peaceful nuclear expolsions in the economy of the Soviet Union are reviewed. (L.C.L.)

33819 SCIENTIFIC BONUS FROM PEACEFUL NUCLEAR EXPLOSIONS. Int. At. Energy Agency Bull.; 12: No. 2, 22-3 (1970).

The possibility of tapping natural resources and creating excavations for civil engineering provide the principal reasons for studying and developing peaceful nuclear explosions. An incidental bonus

may come from the opportunities they could provide for increasing scientific knowledge in some fields. Examples were given in March at an Agency panel on such explosions attended by experts from 30 countries. (auth)

33820 FUTURE OF PLOWSHARE. Kelly, John S. (Atomic Energy Commission, Washington, D. C.). Nucl. News; 13: No. 5, 35-8(May 1970).

A summary is given of the technology of the Plowshare Project and of the accomplishments that have been made. The success in developing the nuclear explosive for excavation is described. Analyses of contained explosions have furnished data on cavity and chimney formation, fracture characteristics, and containment. Progress is reported in using nuclear explosions to create heavy isotopes, an example being the production of fermium-257 starting from uranium-238. Gasbuggy and Rulison demonstrated that government and industry can work together successfully to help develop explosive technology. Interest in the international community is expressed in the inclusion of an article on peaceful nuclear explosions in the Nonproliferation Treaty. A development in the nontechnical area was the introduction of legislation by the United States Congress to extend the AEC's authority to provide nuclear explosion services on a commercial basis. The development of suitable radiation standards for products recovered with the aid of nuclear explosions is being pursued. (J.C.W.)

33821 PLOWSHARE AND RADIOACTIVITY: SAFETY CONSIDERATIONS. Tewes, H. A. (Univ. of California, Livermore). Nucl. News; 13: No. 5, 38-42(May 1970).

Safety evaluations were conducted as part of the Plowshare Project program that involves the earth-moving uses of nuclear explosives. The distribution of the radioactivity resulting from nuclear detonation and the impact of this radioactivity on man were investigated. A review was made of the radiological safety of underground engineering applications and experiments. Appropriate standards for radioactivity present in the biosphere or for radionuclide burdens within the human body are discussed. Advantages that accrue from the use of nuclear explosives for peaceful purposes are balanced against the possible detrimental effects of radiation. (28 references.) (J.C.W.)

33822 ENGINEERING WITH NUCLEAR EXPLOSIVES NEAR POPULATED AREAS. Parker, K. (Atomic Weapons Research Establishments, Aldermaston, Eng.). Nucl. News; 13: No. 5, 43-9(May 1970).

The possible applications of nuclear explosive engineering near populated areas from a West European viewpoint are discussed. The minimization of hazards of nuclear explosives is discussed in such applications as oil storage and stimulation, gas storage and stimulation, shale oil production, stored energy, waste disposal, and mineral exploitation. The hazards arising from the commercial application of nuclear explosives are airblast, radioactivity, and ground motion. Seismic damage effects can vary with geology. All factors are discussed for future development. 26 references. (J.C.W.)

33823 USSR PROGRAM ON PEACEFUL USES OF NUCLEAR EXPLOSIVES. Werth, Glenn C. (Univ. of California, Livermore). Nucl. News; 13: No. 5, 50-3(May 1970).

A discussion of the USSR peaceful uses of nuclear explosions is presented. The Soviets have conducted nuclear experiments in an oil reservoir which is secondary recovery of oil. Proposals and experiments include gas and oil stimulation and gas and oil storage. A 1-kt event in siltstone was described in which the cratering experiment produced a water reservoir. A proposed crater-dam project is described and the plan to transport water into the Caspian Sea is reemphasized. The Soviet mining applications include a contained 1-kt experiment in granite. (J.C.W.)

Facilities and Equipment

Refer also to abstracts 33790, 33852, 33858, 33975, 34513, 34837, 34872, 34881, 34978, 35329, 35330, 35353, and 35354.

33824 (BMBW-FBK-70-1, pp 420-8) METHOD FOR MEASUREMENT OF THE THERMAL CONDUCTIVITY INTEGRAL UNDER IRRADIATION. Stora, J. P. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). (In French).

From European Conference on Thermophysical Properties of Solids at High Temperature.

The technique for measuring the thermal conductivity integral under irradiation is described along with the "Cyrano" irradiation apparatus. The measurement of the heat dissipated in the sample, carried out by means of a preliminary calibration, is described in detail and criticized. Likewise, dosimetric techniques are explained which allow discrimination of the parasitic heatings. (trauth)

33825 (BMBW-FBK-70-1, pp 621-30) THERMAL EXPANSION APPARATUS WITH RHENIUM DILATOMETERS FOR OPERATION TO 2500 C. Moeller, C. Eugene (Midwest Research Inst., Kansas City, Mo.).

From European Conference on Thermophysical Properties of Solids at High Temperature.

An apparatus with a rhenium dilatometer is described for simultaneously measuring the thermal expansion of three specimens to 2500°C in a vacuum or an inert atmosphere. A rhenium heater is used with rhenium and tungsten radiation shields. Ports are provided in the furnace to allow calibration of the dilatometer by telemicroscopes during a test. Retractable chromel/alumel thermocouples are used for temperature measurements below 1000°C; radiation pyrometers are used at higher temperatures; they sight through quartz windows which can be removed and cleaned during operation; possible build-up of deposits on the windows is checked periodically by a retractable black body cavity inside the furnace. The dimensional change of each specimen in the dilatometer is measured with a linear variable differential transformer (LVDT) to provide an electrical signal which is plotted versus temperature on an X-Y plotter. (auth)

33826 (KFKI-70-5-HP) A BIOLOGICAL IRRADIATING FACILITY AT THE HUNGARIAN WWR-SM REACTOR. Makra, S.; Zarand, P.; Sztanyik, L.; Muzsnay, L. (Magyar Tudomanyos Akademia Kozponti Fizikai Kutato Intezete, Budapest). [1970]. 32p. Dep. CFSTI.

The biological irradiation facility constructed at the Hungarian WWR-SM research reactor for the homogeneous irradiation of small biological objects is described. It is suitable for irradiations with variable neutron/gamma ratios. The fast neutron spectra were measured by five different threshold reactions. The dose rate values corresponding to the fast neutron fluxes/bismuth filter between 0 and 145 mm/ vary from 10.45 to 1.04 rad s^{-1}. The dose rates due to thermal neutron flux amount to 1-3 percent of the fast neutron dose rate. The gamma dose rate was measured with thermoluminescent dosimeters (BeO_2 TLD-700 and TL glass). It varied between 0.194 and 12.3 rad s^{-1}. The dose rates were measured assuming that the biological object to be irradiated has a composition corresponding to that of the "standard man." If this assumption is not valid (e.g., blood) a correction is necessary. The neutron flux values were obtained by calculation too, using the discret ordinates method. The calculated and measured fluxes are in good agreement. (auth)

33827 (MSAR-70-9) PRODUCT SURVEY REPORT, PHASE 1, TASK 2. MOISTURE SEPARATOR DEVELOPMENT PROGRAM. Topical Report No. 2. Griwatz, Gunther H. (MSA Research Corp., Evans City, Pa.). 21 Jan 1970. Contract AT(45-1)-2145. 33p. Dep. CFSTI.

The commercial availability of products for use in the separation of entrained moisture from gas streams under conditions ranging from standard air to those encountered during a pressurized water reactor loss of coolant incident was surveyed. All known suppliers of separator assemblies and a cross-section of likely component suppliers were contacted. Of 135 potential suppliers contacted, 47 did not reply; 55 could not supply suitable separators or components; 12 proposed to furnish separators while 3 declined; and 18 offered media for separator service. Two separator assemblies, one manufactured by MSA and the other manufactured by York, are on hand for performance test evaluation. No other units are recommended for purchase and testing as will be explained in the body of this report. Testing of media samples has been started at ambient temperature and pressure to identify those best suited for testing at PWR incident conditions. (auth)

33828 (NASA-SP-5081) ADVANCEMENTS IN TELEOPERATOR SYSTEMS. A Colloquium held at the University of Denver, Denver, Colorado, February 26-27, 1969. An AEC-NASA Technology Utilization Publication. (National Aeronautics and Space Administration, Washington, D. C.). 1970. 243p. (CONF-690213). Dep. CFSTI.

The complete proceedings of the 1969 conference on recent advancements in the design, operation, performance, and uses of teleoperator systems are presented. The teleoperator systems applications discussed include the handling of radioactive materials, handling of materials in any hostile environment, space and underwater applications, medical uses, and artificial limbs or prosthetics. (L.C.L.)

33829 (TID-4100(Suppl.58)) ENGINEERING MATERIALS LIST. Smith, Richard, J.; Sachs, Francis L.; Clark, Willie E. (eds.) (Division of Technical Information Extension (AEC), Oak Ridge, Tenn.). Jun 1970. 39p. DTIE Free.

Twenty-one packages of engineering drawings and specifications are presented for sodium centrifuge, diffraction neutron monochromator, TRU shipping carrier, laser interferometer, spindle checker system, ribbon parachute, eddy-current velocity transducer, DXT gaging system, continuous sampler monitor, sodium level indicator, cross-beam neutralizer, vacuum gate valve, six-stage pump and glass bearings, dry waste press, current-to-frequency converter, electronic engineering trailers, air monitor detector probe, steam-lubricated rotor-bearing system, gripper for EBR-II fuel unloading machine, drop calorimeter system, and neutron criticality detection system. A subject index is included. (L.C.L.)

33830 CALORIMETRIC DOSIMETRY OF NEUTRON RADIATION FROM THE REACTOR VVR-M. Kolyada, V. M.; Karasev, V. S. This paper was summarized in At. Energ. (USSR); 26: 55-6(Jan 1969) as paper No. 254. (In Russian).

Calorimetric data are used to find the absorbed dose of thermal and fast neutrons in materials composed of elements Z = 1 through 42 irradiated in VVR-M reactor. Methods of calculation are described and data on the absorbed dose are tabulated. (J.R.D.)

33831 CALORIMETRIC INVESTIGATION OF THE PERTURBATION OF NEUTRON FLUXES BY ABSORBING MATERIALS. Kolyada, V. M.; Karasev, V. S. This paper was summarized in At. Energ. (USSR); 26: 56(Jan 1969) as paper No. 255. (In Russian).

Results of an investigation in which the thermal action of reactor radiation on solids is used in calculating the irradiation parameters associated with radiation effects. The specimens being irradiated constituted the dosimetric medium, and absorber nuclei burnup was determined with respect to the heat release. (J.R.D.)

33832 IMPROVED GLOVE BOX WITH HIGH PURITY ATMOSPHERE. Gardner, H. J. (CSIRO, Melbourne). J. Phys., E (London); 3: 569-70(Jul 1970).

Modifications and performance are given for a glove box with high purity atmosphere by absorption of H_2O, O_2, N_2 and other impurities. (auth) (UK)

33833 SUPPORT FOR VESSEL A NUCLEAR REACTOR. Freour, Andre (to Societe Pour l'Industrie Atomique S.A.). French Patent 1,544,092. 23 Sep 1968. Filed 15 Sep 1967. (In French).

A support device for the vessel of a liquid-moderated nuclear reactor is described. The support consists of a prestressed concrete caisson which marks off a cavity in which a vessel containing the core and moderator is placed. The support caisson has vertical gates fixed to the bottom of the vessel and to the lower part of a seat cylindrically arranged in the bottom of the prestressed concrete caisson. The caisson has thermal insulation. In each seat there is a solid annular block of the casing tube, and the support gates are tubes. Each support tube is fixed to an orifice in the bottom of the moderator vessel. An air-tight sealing tape is attached to the support tube inside the vessel. (J.S.R.)

33834 ULTIMATE PRESSURE ANALYSIS OF DEEP END SLABS FOR PRESTRESSED CONCRETE PRESSURE VESSELS. Campbell-Allen, D.; Low, E. W. E. (Univ. of Sydney). Nucl. Eng. Design; 12: 69-79(May 1970).

An analysis was developed which was used to describe the possible ultimate strength of deep slabs under internal pressure. In the analysis it is assumed that a mode of failure has been shown to occur experimentally under some conditions, and it is demonstrated that this assumption gives reasonable bounds to the ultimate pressure for a considerable range of prestress. The analysis is based on an assessment of the strength of concrete under triaxial compressive stress and the data relating to strength under these conditions are reviewed. (auth)

33835 REPROCESSING FACILITY, BUILDING 71 (11 Mar 1970) (Engineering Materials). (Dow Chemical Co. Western Div., Pittsburg, Calif.). (CAPE-1185).

37 drawings.

Drawings for the expanded reprocessing Pu purification plant are described including the materials balance, flow diagrams for americium and low-level anion exchange, glove boxes, rotary drum filters, traps, process vessels and piping. The glove box for the H-4 Nash pump is supported on a concrete base. The box is fabricated of stainless steel framing and sheets of ½ in. thick Plexiglas. Other glove-box drawings describe air locks, windows, glove ports, filters, frames, and sample take-out ports. The rotary drum filters are used in filtering PuO solutions following precipitation of insoluble residues from leaching solutions during production purification. The ball float vacuum trap uses a hollow polyethylene ball which seats to form a bubble-tight seal. The other vacuum trap is used in connection with a glove box. The vacuum for the trap is supplied from the glove box. Processing vessels and piping drawings describe both horizontal and vertical tanks, ion-exchange columns, vacuum knock-out pots, an evaporator, and a 400 gal chemical make-up waste tank. (For details see TID-4100 Suppl. 59) (F.S.)

33836 ^{13}C PRODUCTION PLANT (19 May 1979) (Engineering Materials). (Los Alamos Scientific Lab., N. Mex.). (CAPE-1970).

27 drawings.

A fractional distillation plant is described, which produces 4 kg/year of ^{13}C at 95% concentration. Multiple parallel columns are used in the early separation stages. Carbon monoxide is employed in producing ^{13}C by low-temperature distillation in a 140 ft long stainless steel column which is packed with wire helices. The bottom 80 ft section of the column is a single 1 in. dia tube. The middle 20 ft section is made up of four 1 in. dia tubes in parallel. The top section, which is 40 ft long consists of 12 tubes, 1 in. dia in parallel. Hollow transition manifolds are used to reduce the gas flow from the 12 to the four tubes and from the four to the one tube as the gas flows down the column. The distillation column is enclosed in a 6 in. dia dural vacuum jacket which is equipped with styrofoam spacers and aluminized Mylar film insulation. The vacuum jacket is located in an 18 in. dia steel liner. The column is fed in the top section with 135 M CO/day. About 1000 l/day of liquid N is used, half of which is employed to condense CO. About 1 kW of heat per day is required. A continuous CO detector samples the air and alarms if 50 ppM CO is detected in the air. If the product is desired as CO_2, the gas is passed through a tube containing CuO at 400°C and the converted gas is trapped cryogenically in a pressure cylinder. The cylinder, when warm, contains liquid CO_2 at 750 psi pressure. (For details see TID-4100 Suppl. 59) (F.S.)

Heat Transfer and Fluid Flow

Refer also to abstracts 33827, 34837, 34870, 35323, 36027, 36028, and 36072.

33837 (GA-9264) TAC3D: A GENERAL PURPOSE THREE-DIMENSIONAL HEAT TRANSFER COMPUTER CODE: MATHEMATICAL FORMULATIONS AND PROGRAMMER'S GUIDE. Clark, S. S.; Del Bene, J. V.; Petersen, J. F. (Gulf General Atomic, Inc., San Diego, Calif.). Sep 1969. Contract AT(04-3)-167. 242p. Dep. CFSTI.

TAC3D is a code for calculating steady-state and transient temperatures in three-dimensional problems by the finite difference method. It is written entirely in Fortran V. The configuration of the body to be analyzed is described in the rectangular or cylindrical coordinate system by orthogonal planes of constant coordinate called grid planes. The grid planes specify an array of nodal elements. Nodal points are defined as lying midway between the bounding grid planes of these elements. A finite difference equation is formulated for each nodal point in terms of its capacitance, heat generation and heat flow paths to neighboring nodal points. A system of these equations is solved by an implicit method which is one of the most efficient known at this time. Advantages of the code include those described as the geometrical input is simple; the input of thermal parameters is by Fortran V arithmetic statement functions. Many of the calculation variables (time, local temperature, local position, etc.) are available for use in these functions; internal and external flowing coolants may be used; there may be internal and external thermal radiation; and there is a wide selection of optional output. The principal limitations of the code are: the grid plane system must be orthogonal in the rectangular or cylindrical coordinate system and therefore the sides of the nodal elements must also be orthogonal; all radiation is treated one-dimensionally; and there are no provisions for thermal expansion or change of phase. (Such special heat transfer situations could be included by extensions of the existing programming.) TAC3D has been assigned operational status. The machine requirement is a 65K Univac 1108, or equivalent. In addition to input-output, a maximum of four and a minimum of no external devices are required depending upon the code options being used. The operating system under which the code has been successfully used is EXEC II as modified for Gulf General Atomic. Running time depends upon the size and complexity of the problem and is not easily defined. (auth)

33838 (LMEC-68-5(Vol.2)) MECHANICAL ELEMENTS OPERATING IN SODIUM AND OTHER ALKALI METALS. VOLUME II. EXPERIENCE SURVEY. Kniley, D. J.; Carlson, W. J.; Ferguson, E.; Jenkins, O. G. (Atomics International, Canoga Park, Calif. Liquid Metal Engineering Center). 1 Jun 1970. Contract AT(04-3)-700. 313p. Dep. CFSTI.

The operating history of sodium service mechanisms used in the following sodium-cooled reactors is presented: the Sodium Reactor Experiment, the Experimental Breeder Reactor II, the Enrico Fermi Atomic Power Plant, and the Hallam Nuclear Power Facility. Included are mechanism component design characteristics, operating conditions, their operability and maintainability, and the history of component malfunctions with the subsequent repairs or modifications required. It is concluded that an adequate design basis does not presently exist. (auth)

33839 TWO-PHASE CRITICAL FLOW AT LOW QUALITIES PART I. EXPERIMENTAL. Henry, Robert E. (Argonne National Lab., Ill.); Fauske, Hans K.; McComas, Stuart T. Nucl. Sci. Eng.; 41: 79-91(Jul 1970).

Steam-water, two-phase critical flows were obtained in long pipes (L/D > 40) for mass flow rates ranging from 512 to 6460 lbm/(sec ft^2), exit pressures from 40 to 150 psia, and thermodynamic equilibrium qualities from 0.0019 to 0.216. A comparison of the three test sections employed indicates that previous experimental data are in error for qualities less than 0.10 due to the influence of the downstream two-dimensional expansion on wall pressure taps located near the exit plane. Although simultaneous temperature and pressure measurements were not taken, the data exhibit trends that suggest the existence of a nonequilibrium phase change. Experimentally determined exit and axial void fractions indicate (a) that the velocity ratios are considerably less than the existing analytical predictions and (b) that previously dissolved gases existing from the liquid provide a source for vapor formation under adiabatic subcooled conditions. (auth)

33840 TWO-PHASE CRITICAL FLOW AT LOW QUALITIES. PART II. ANALYSIS. Henry, Robert E. (Argonne National Lab., Ill.); Fauske, Hans K.; McComas, Stuart T. Nucl. Sci. Eng.; 41: 92-8(Jul 1970).

A model is developed to predict one-component two-phase critical flow for equilibrium qualities less than 0.02. The formulation approximates the real nonequilibrium processes by thermodynamic equilibrium paths. The deviations from equilibrium are incorporated in one function which can be determined experimentally. The model exhibits good agreement with the experimental data for exit pressures from 50 to 150 psia. (auth)

33841 ANALYSIS OF BOW SHOCK STRUCTURE AT A STAGNATION POINT SUBJECTED TO EXTERNAL RADIATION. Lilly, Julius Quentin. University, Ala.; Univ. of Alabama (1969). 101p.

Thesis.

The effects of external source radiation on the viscous hypersonic shock layer are investigated. The problem corresponds to the condition that could be encountered by a hypersonic missile in flight near a nuclear blast. The conservation equations are obtained for a viscous, hypersonic, radiating stagnation region flow. The radiative heat flux is obtained for the plane parallel slab approximation considering emission and absorption of radiation in the shock layer. A two-step model approximation to the spectral absorption coefficient of air is developed from detailed spectral data and used in this investigation. Real gas thermodynamic and transport properties are utilized in the form of correlation equations. The Lees-Dorodnitsyn transformations are used to transform the conservation equations, then a similarity solution is obtained using a fourth-order Runge-Kutta iterative procedure. Comparison of solutions with previous radiating and nonradiating stagnation heating results are presented. Numerical solutions are presented for free stream conditions of 0.1 atm pressure, 1000°K temperature, 1000 Btu/ft^2-sec external radiative flux, and flight velocities of 10,000, 20,000, and 30,000 ft/sec nose radii between 0.1 and 1.0 ft. The body temperature is held constant at 2000°K. Comparison of results is made with and without external radiation. The results show that the external radiation has an almost negligible effect on the stagnation region flow field if the external radiation is transmitted at wavelengths greater than 1800 Å. For external radiation transmitted in the 1300- to 1800-Å range, a significant reduction in the radiative flux to the body is obtained without a corresponding increase in the convective heating. It is found that the shock standoff distance, velocity, and enthalpy profiles in the shock layer are not significantly affected by an external radiative flux of this magnitude. (Diss. Abstr. Int., B)

33842 CALCULATION OF HYDRODYNAMICAL CHARACTERISTICS OF TURBULENT FLOW IN RECTILINEAR CHANNELS. Kashcheev, V. M.; Nomofilov, E. V. This paper was summarized in At. Energ. (USSR); 26: 280-1(Mar 1969) as paper No. 264. (In Russian).

A general system is derived which consists of five partial differential equations for determining the three velocity components, the pressure, and the turbulent viscosity of turbulent flow in a rectilinear channel. It is assumed that the turbulent viscosity coefficient is scalar and independent of the type of transportable substance, and that the effective velocity of the reverse flow is known. The flow is assumed to be laminar in the thin layers near the walls. In the remainder of the channel the flow is turbulent. Continuity of the velocity is assumed at the boundary between the laminar and turbulent regions. The results show that it is possible to use the system of equations to calculate the hydrodynamic characteristics of a turbulent flow. (L.C.L.)

33843 RADIATION-PRODUCED THERMAL SHOCK ON A REFRACTOR WALL LINING. Letort, Yves Bull. Soc. Fr. Ceram.; No. 84, 35-42(1969). (In French).

The limiting case of a cold refractory wall being instantaneously radiantly heated by a hot refractory wall is considered. The stress a cooling body undergoes when prevented from contracting is calculated. The maximum temperature variation it can stand is determined. The phenomena resulting from a thermal shock are described. The instantaneous rupture in the hot wall is considered for the three cases of a rupture with critical dimensions, a rupture with dimensions smaller than critical, and a rupture with dimensions larger than critical. Practical applications are briefly considered. (J.S.R.)

Isotope Technology

Refer also to abstracts 33836, 33860, 33930, 34195, and 34562.

33844 (CEA-R-3975) VALIDITY OF RADIOACTIVE STANDARDS. Le Gallic, Yves; Thenard, Marie (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Mar 1970. 52p. (In French). Dep. CFSTI (U. S. Sales Only).

There are three types of radioactive standards: primary standards, secondary standards and reference sources. Primary standards have a great interest especially to provide a good reliability of the standards which are delivered by a National Laboratory. Secondary standards are the most commonly used, but it is necessary to be confident in their validity. The elaboration of these standards and some considerations on various error factors are studied. Several international intercomparisons to which the L.M.R. takes part in, show the interest of these intercomparisons to qualify a laboratory but also point out the need of primary standards. (auth) (France)

33845 (MLM-1614) STABLE GASEOUS ISOTOPE SEPARATION AND PURIFICATION, OCTOBER-DECEMBER 1969. (Mound Lab., Miamisburg, Ohio). 8 May 1970. Contract AT-(33-1)-Gen-53. 60p. Dep. CFSTI.

Developments are reported for studies on: separation of carbon isotopes; separation of stable isotopes of argon, krypton, neon, and xenon; cascade theory, molecular beam scattering, and transport properties in thermal diffusion; and helium isotope separation and thermal transpiration. (J.C.W.)

33846 (TID-25372) DIVISION OF ISOTOPES DEVELOPMENT RESEARCH AND DEVELOPMENT PROJECTS: 1969 Progress Reports on Sponsored Work. (Division of Isotopes Development (AEC), Washington, D. C.). Feb 1970. 166p. Dep. CFSTI.

A 1969 summary of the objectives, progress, results, and future plans for each of the research and development projects of the AEC Division of Isotopes is presented. The projects are separated into the following categories: radioisotopes production and materials; thermal applications development; uses in environmental and ocean sciences; radiation analysis and control; process radiation; radiation preservation of foods; and information services related to radioisotopes uses. (L.C.L.)

33847 MECHANISM OF ELECTROSPRAYING. Shorey, J. D.; Michelson, D. (Brunel Univ., London). Nucl. Instrum. Methods; 82: 295-6(1970).

A study was made to determine the parameters governing the formation and stability of the spray for a number of polar liquids for the preparation of thin radioactive films. The dielectric constant and the surface tension were found to be dominant. A theoretical explanation is suggested. (auth)

33848 PRESENT STATE OF URANIUM ENRICHMENT. Kawamo, Keishiro (Science and Tech. Agency, Tokyo). Shin Kinzoku Kogyo; 14: 333-5(Dec 1969). (In Japanese).

The state of uranium enrichment is described. The background for the emergence of the problem of uranium enrichment, the promising future of atomic power generation, increase in the demand of enriched uranium, the transfer of enrichment service to private firms in the U. S., trend in European countries, and

atomic power generation in Japan are considered. Significance of research and development on uranium enrichment, the future demand of enriched uranium, and the necessity for the research and development on uranium enrichment are discussed. (NSA of Japan)

Materials Testing

Refer also to abstracts 33834, 33863, and 34837.

33849 (BNWL-1349-1, pp 8.1-37) NONDESTRUCTIVE TESTING. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

From Reactor Fuels and Materials Development Programs for Fuels and Materials Branch.

Results of research and development of eddy current methods, ultrasonic methods, thermal methods, and holographic methods are presented. (J.R.D.)

33850 (CONF-671061-(Vol.1)) PROCEEDINGS OF THE 4th CONGRESS FOR MATERIALS TESTING. I. MECHANICAL TECHNOLOGICAL TESTING, OCTOBER 11-14, 1967, BUDAPEST. (Scientific Society of Mechanical Engineers, Budapest (Hungary)). 319p. (In German and English).

Fifty-three papers were presented at the conference. A separate abstract was prepared for one. Fifty-two were not within the scope of NSA. (L.C.L.)

For an abstract of one paper see: 33851.

33851 (CONF-671061-(Vol.1), pp 121-41) NON-DESTRUCTIVE TESTING OF SAP REACTOR PRESSURE TUBES. Albertini, C.; Montagnani, M.; Weltevreden, P. (Scientific Society of Mechanical Engineers, Budapest (Hungary)).

One of the basic components of organic-cooled heavy water-moderated reactors is the pressure tube assembly. In the "hot pressure tube" version, the pressure tube operates at the reactor coolant temperature and must withstand the coolant pressure over the entire life of the reactor. In order to test this assembly under operating conditions, a certain number of these are mounted in a test reactor specifically designed for this purpose. Before mounting the assemblies, a selection of pressure tubes delivered by the manufacturer was tested by destructive and nondestructive methods. The nondestructive testing included: metrology, endoscopy, fluorescent liquid checking, ultrasonic testing, and x-ray testing. The destructive testing included: tensile testing at room temperature, tensile testing at 420°C, chemical and activation analysis, residual stress, and creep testing. Special attention was paid to the latter item and creep tests on specimens cut from the tube wall as well as creep tests on complete tube sections were performed. A statistical evaluation of creep data resulted in admissible stress levels as a function of temperature. (auth)

33852 (RD/B/N-1607) TRANSMISSION OF NOISE THROUGH STRUCTURES OF COMPLEX SHAPE. Whitton, P. N. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). Feb 1970. 12p. Dep. CFSTI (U. S. Sales Only).

A method is proposed for determining the sound pressure level in a gas cavity excited only by transmission of sound into it through its walls. The method is used in a particular reactor configuration to determine the noise transmission between two cavities separated by steel platework. (auth) (UK)

33853 (TRG-Report-1983) ACOUSTIC EMISSION FROM STEEL PRESSURE VESSELS. Nielsen, A.; Latham, F. G.; Kirby, N. (United Kingdom Atomic Energy Authority, Risley (England). Reactor Group). Apr 1970. 13p. Dep. CFSTI (U. S. Sales Only).

Preliminary investigations were made of acoustic emission from mild steel pressure vessels. Using Piezoelectric accelerometers of 60 kHz and 120 KHz natural frequency the acoustic activity was found to be high in the initial stages of pressurization and to decrease at higher pressures. A similar pattern was followed by vessels containing large defects although the rate of emission was greater. There was no significant increase in the rate of emission as the vessels approached failure. Repeated pressurization of vessels showed reduced acoustic activity on second and subsequent pressure cycles especially when the rest period between cycles was short. Further investigation is necessary to relate acoustic signals (in terms of amplitude, rate and frequency) with metallurgical changes (deformation, cracking, tearing etc.) in the structure. (auth) (UK)

33854 TWO METHODS OF HYDROGEN IMPURITY CONTROL IN SODIUM SYSTEMS. Arnol'dov, M. N.; Ivanovskii, M. N.; Shmatko, B. A. This paper was summarized in At. Energ. (USSR); 27: 333-4(Oct 1969) as paper No. 344/5220. (In Russian).

Monitoring hydride impurities in sodium coolants is of great practical importance as it makes it possible to observe the development of leaks in the sodium-water steam generator. A sodium circulating test stand was operated isothermally at 350° for the investigations. The hydrogen concentration in the sodium was monitored continuously with the help of a conductometrical indicator. The data obtained showed that the monitoring of hydrogen content in sodium based on the use of a gas-filled cavity with a weak hydrogen source inside the metal will show a considerable delay. The establishment of the hydrogen equilibrium distribution in the system was determined by the kinetics of thermal dissociation was a power function of the reciprocal temperature, it was expedient to place the controlling gas cavity in a zone of the system where the sodium temperature is highest. Hydrogen monitoring in the metal itself worked more rapidly than the monitoring through a gas bubble. In the case of hydrogen gas bubbles from the metal joining the gas volume, which may happen when the metal contains strong sources, both methods of hydrogen monitoring can complement one another. (G.M.C.)

33855 ACOUSTIC APPARATUS TO RECORD EMISSIONS FROM CONCRETE UNDER STRAIN. Wells, D. (Atomic Weapons Research Establishment, Southend-on-Sea, Eng.). Nucl. Eng. Design; 12: 80-8(May 1970).

The design of an apparatus to detect the sound emitted by small concrete specimens under strain is described. The acoustic equipment assembled to detect and record these minute sounds is described together with the steps taken to minimize the effects of background noises. An account is given of the machinery developed to apply load at a noise level low enough not to be detected by the acoustic equipment. Some typical results are shown. (auth)

33856 ROUND-ROBIN TESTS TO DEVELOP A STANDARD AUTOCLAVE TESTING PROCEDURE FOR ZIRCONIUM ALLOYS. Bryant, P. E. C. (Atomic Energy of Canada Ltd., Chalk River, Ont.). ASTM (Amer. Soc. Test. Mater.) Spec. Tech. Publ.; No. 458, 360-71(1969).

From Symposium on Applications-Related Phenomena in Zirconium and Its Alloys, Philadelphia, Pa. See ASTM-STP-458; CONF-681105.

Two interlaboratory tests were conducted, the first with Zircaloy-2, the second with 2.5 Nb-Zr alloy, to formulate standard autoclave test procedures for zirconium alloys. In Interlaboratory-1, each laboratory used its own test procedure. The large scatter in data was attributed primarily to differences in autoclave start-up techniques, with minor contributions from variations in pickling time, and residual oxygen remaining in the autoclaves. Standard coupon preparation techniques were invoked for the 2.5 Nb-Zr alloy for Interlaboratory-2; ASTM proposed standard G-2, 1967, was used for autoclave start-up. The good reproducibility from Interlaboratory-2 confirmed the acceptability of the proposed ASTM standard autoclave procedure. Decreased corrosion of annealed 2.5 Nb zirconium with time was attributed to the monotectoid transformation of Nb enriched β_{Zr} to α_{Zr} plus β_{Nb}. (auth)

33857 METHOD OF INSPECTION OF WELDS. Soulat, Pierre (to Commissariat a l'Energie Atomique). British Patent 1,195,620. 17 Jun 1970. Priority date 13 Nov 1967, France.

A method is described for the radiographic inspection primarily of the joint formed between an end-cap and a tubular can, both of magnesium or a magnesium alloy, which forms part of a reactor fuel element. This inspection method is applicable to welds formed by electron beam welding of metallic parts. (G.M.C.)

33858 TUBING TRANSPORT SYSTEM (30 Jun 1970) (Engineering Materials). (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). (CAPE-2008).

21 drawings.

A tubing transport system, which is used with an ultrasonic flaw inspection system, provides relative movement between the ultrasonic test heads and the tubes, so that tubes can be inspected in an accurate helical path. This is accomplished by "chucking" the tubes at both ends on mandrels. The mandrels are driven by an 1800 rpm motor to provide the tube rotation. Tubes up to 10 ft long can be inspected. A tank or weir box, containing the test heads, is translated the entire tube length by a motor driven lead screw. The transport system consists of a table, goniometer, slide, steady rest, tank, and a tube drive head. The goniometer consists of a stainless-steel slide and shaft, brass guide and worm gear, and bronze bushings. The slide employs brass knobs, brackets, male dovetail, feed nut, end plates, and stainless steel slides. The steady rest is made of stainless steel cams and roller shafts, brass roller yokes, and Al arms and roller brackets. (For details see TID-4100 Suppl. 59) (F.S.)

Radioactive Material Handling

33859 (BNWL-1385) ROLE OF STATISTICS IN SAFEGUARDS. Stewart, K. B.; Jaech, J. L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). May 1970. Contract AT(45-1)-1830. 32p. Dep. CFSTI.

Certain specific uses of statistics in connection with safeguards, both current and projected, are discussed. The principal theme is that the application of statistics plays an important role in safeguarding nuclear materials, and that statistics should become an increasingly important tool in the safeguards field. (auth)

33860 (BRH/SERHL-70-1) LABORATORY EXAMINATION OF A RUPTURED 50-mg RADIUM SOURCE. Bedrosian, P. H.; Gels, G. L. (Southeastern Radiological Health Lab., Montgomery, Ala.). May 1970. 13p. CFSTI.

A procedure for safely handling a ruptured radium source is described. The technique employed was designed to prevent leakage of radium to the environment and also to minimize radiation exposures to personnel. A photographic leak-test method developed at the Southeastern Radiological Health Laboratory, Bureau of Radiological Health, was also tested with the ruptured source. Measurements and photographic evaluation of the rupture and assessment of radium losses from the source are documented. (auth)

33861 (NYO-841-22) HARVARD AIR CLEANING LABORATORY SEMIANNUAL PROGRESS REPORT, SEPTEMBER 1, 1969-FEBRUARY 28, 1970. First, M. W.; Goldin, A. S.; Grubner, O.; Reist, P. C.; Underhill, D. W.; Viles, F. J. Jr.; Yusa, H.; Baldwin, T.; Moeller, D. W. (Harvard School of Public Health, Boston, Mass.). Apr 1970. Contract AT(30-1)-841. 45p. Dep. CFSTI.

Research progress is reported on the evaluation of the performance of industrial fabric filters composed of Teflon and glass for the removal of sodium fume and combustion products. The physical and chemical properties of sodium aerosols have been investigated and reveal that for a given containment shape and volume, the aerosol concentration shortly after a sodium burn has ceased is independent of the amount of sodium burned or the peak concentration during the burn. Experimental procedures and apparatus have been developed to study the behavior of fission product iodine in a sodium environment. A preliminary schematic design of an adsorption bed for the holdup of radioactive noble gas releases from the Fast Flux Test Facility has been prepared. A detailed summary of the equations and data used in developing the design of the noble gas adsorption system is given. (J.C.W.)

33862 (RT/ING-(69)20) HOT CELLS FOR POST-IRRADIATION EXAMINATION OF SAMPLES OF LOW ACTIVITY. Cesarano, C.; Lauro, M.; Lepscky, C.; Pugnetti, G.; Sartori, S. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 21 May 1969. 41p. (In Italian). Dep. CFSTI (U. S. Sales Only).

The hot laboratory of Casaccia is equipped with high activity hot cells for post irradiation examination of fuel elements. In addition to them some lead brick cells for special examination have been built. Special examination deals with low activity samples and requires delicate or expansive experimental equipment to be totally or partially shielded. Therefore the hot cells have been designed in order to suit the equipment, while in the high activity cells the equipment is designed to suit the dimensions and the available space and facilities of the hot cells. (auth)

33863 (SZS-5/70) OBSERVATIONS ON TESTING METHODS FOR LEAK DETECTION IN PACKAGES OF RADIOACTIVE MATERIALS. Birkigt, W. (Staatliche Zentrale fuer Strahlenschutz, Berlin (East Germany)). Apr 1970. 29p. (In German). Dep. CFSTI (U. S. Sales Only).

A brief review is given on leakage tests. Their suitability for packages of radioactive materials is evaluated. Most appropriate for the detection of the recommended leakage rates of type A and B packagings are leakage tests with halogen leak detectors, helium leak detectors, ^{85}Kr, the gas bubble test, and the method of pressure increase. (auth)

33864 SAFE TRANSPORT OF NUCLEAR MATERIALS. Int. At. Energy Agency Bull.; 12: No. 2, 24-5(1970).

A comprehensive review by world experts of regulations prepared by the Agency for the safe transport of radioactive materials has now been completed. Their recommendations and decisions will be assembled into a draft to be sent to the 103 Member States and to international air, sea, river and land transport organizations for comments and suggestions. The revised text may be completed, approved by the Board of Governors and published in about two years. (auth)

INSTRUMENTATION

Radiation Detection Instruments

General Detectors and Monitors

Refer also to abstracts 33945, 34441, 35773, and 36064.

33865 (AD-702755) TIME-RESOLVED MEASUREMENT OF DROPLET SIZE AND CONCENTRATION IN CLOUD CHAMBERS. Cole III, John E.; Dobbins, Richard A.; Semerjian, Hratch (Brown Univ., Providence, R. I. Div. of Engineering). Mar 1970. Contract N00014-67-A-0191-0001. 28p. CFSTI.

An optical method for measuring droplet size and concentration in a cloud chamber on a time-resolved basis is discussed. During the growth of the droplets, optical transmission is continuously measured by high speed electronic equipment at two wavelengths. Interpretation of the resulting transmission versus time curves is made on the basis of Mie scattering theory. The appearance of oscillatory regions in the transmission curves is related to the primary oscillations of the scattering coefficient and indicates the presence of a monodisperse cloud. Two methods of data interpretation are discussed from which absolute values of droplet size and concentration are obtained. The technique is applicable to condensation studies conducted in Wilsen cloud chambers. It is suggested that apparatus of the type described is also suitable for the absolute calibration of condensation-nuclei counters of various types. (auth) (USGRDR)

33866 (AD-702987) A LITERATURE SURVEY OF RECENT ARTICLES ON GEIGER-MUELLER COUNTERS AND GAS-DISCHARGE PHENOMENA ASSOCIATED WITH THEIR OPERATION. Wisotsky, S.; Korff, S. A. (New York Univ., N. Y.). Sep 1968. Contract DAHC20-68-C-0137. 26p. CFSTI.

The survey of the available literature was made during the summer of 1965. It lists papers pertaining to Geiger–Mueller counters, their construction and operation, and some of the many and complex gas-discharge phenomena associated with their operation. (auth) (USGRDR)

33867 (IFVE-SEF-69-22) HODOSCOPE SYSTEMS IN CROSSED FIELDS. Aleksandrov, N. F.; Vishnevskii, N. K.; Korolkova, O. S.; Lapshin, V. G.; Leitezen, L. G.; Rykalin, V. I.; Solyanik, V. I.; Khromov, V. P. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1969. 13p. (In Russian). Dep. CFSTI (U. S. Sales Only).

A hodoscope system in crossed magnetic and electrical fields with fast plastic scintillators is described. This system in accordance with a number of characteristics can be considered as an intermediate system between wire chambers and conventional scintillation hodoscopes. Also, some possibilities of using this system for filmless readout of the information from the spark chambers are discussed. (auth)

33868 (JINR-P13-5065) PULSE SHAPER TRIGGERING FROM FIXED PART OF THE PULSE AMPLITUDE OF THE PHOTOMULTIPLIER. Ondrish, L.; Mukhin, S. V.; Rikhvitskii, S. V.; Semenyushkin, I. N.; Horvath, P.; Khrenov, A. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1970. 15p. (In Russian). Dep. CFSTI (U. S. Sales Only).

A pulse shaper of a scintillation counter triggering from the fixed part (15%) of the pulse amplitude is described. The output pulse amplitude is equal to 1V at the resistance 50 ohm and time duration—15 nsec. Changing input amplitude from 0.15 to 9.00 V one obtains bias of the output amplitude <±100 psec. Time resolution of 160 psec was obtained by testing in a 5 GeV/c π^--beam. (auth)

33869 (ORNL-TM-2826) MECHANISMS AND APPLICATIONS OF NUCLEAR TRACK REGISTRATION IN POLYMERS. Johnson, D. R.; Becker, Klaus (Oak Ridge National Lab., Tenn.). Jun 1970. Contract W-7405-eng-26. 47p. Dep. CFSTI.

The radiolytic damage mechanism for latent nuclear track formation in polymers has been corroborated using a stable free radical, DPPH, as a radical scavenging additive to sensitive cellulose nitrate and cellulose acetate foils. The G-value for free radical production has been measured as a function of linear energy transfer, and environmental effects on the track registration efficiency have been studied. For the automatic counting of etched alpha particle tracks and the imaging of their spatial distribution, a technique based on the local evaporation of a thin metal layer with electrical discharges occurring through perforations in cellulose nitrate foils has been developed. This method has been used for the evaluation of a newly developed radon progeny personnel dosimeter for uranium miners; for the ultrasensitive determination of quantity and distribution of fissile materials in biological and other samples (plutonium in bone, uranium in water and air) by neutron-induced autoradiography; and for increasing the sensitivity in quantitative alpha-autoradiography. (auth)

33870 (TUBIK-20) RADIATION DETECTORS: A PROGRAMMED INTRODUCTION. Lindauer, Erwin (Technische Universitaet, Berlin (West Germany). Institut fuer Kerntechnik). Mar 1970. 113p. (In German). Dep. CFSTI (U. S. Sales Only).

A workbook manual on radiation detectors is presented. The physical basis for nuclear radiation measurement techniques, operational principles of the individual classes of detectors, types of gas-filled detectors, and properties of different detectors are considered. (J.S.R.)

33871 RESPONSE OF POSITION-SENSITIVE DETECTORS TO FISSION FRAGMENTS AND OTHER HEAVY IONS. Kaufman, S. B.; Wilkins, B. D.; Fluss, M. J.; Steinberg, E. P. (Argonne National Lab., Ill.). Nucl. Instrum. Methods; 82: 117-21(1970).

Position-sensitive surface barrier detectors have been used for the measurement of energy and angular distributions of fission fragments and other heavy ions. The techniques used to calibrate such detectors are described. It is possible to determine the position of an incident ion with a resolution of about 0.25 mm for a 50 mm detector length, the position response being independent of the energy of the ion. However, the position response curve is non-linear, showing its largest curvature at one end of the detector. The pulse height versus energy calibration was determined for a variety of heavy ions produced by elastic scattering of ^{32}S and ^{16}O. The ions Ni, Ag and Au exhibited pulse-height defects, which were measured as a function of ion energy, and were found to be approximately equal to those for a "heavy ion" type surface barrier detector. The pulse height versus energy calibration is a function of position, but is linear at a given position. In spite of the slow rise time of the pulses, it was possible to obtain fast timing signals, with a resolution of 3.5 nsec (fwhm) at a fixed position and fixed energy. The time dependence on position, however, is very large with about 50 nsec difference between the center of the detector and the ends. (auth)

33872 COMBINATION RADIACMETER FOR DOSE-RATE OR DOSE MEASUREMENT. Nirschl, J. C. (Army Electronics Command, Fort Monmouth, N. J.). Nucl. Instrum. Methods; 82: 77-85(1970).

Design features of a developmental radiacmeter are reviewed, which uses a solid-state (MOSFET) electrometer in either a current (dose-rate) measuring or charge integrating (dosimeter) mode. Protective measures against radiation-induced instability of the MOSFET devices are discussed, as well as the inherently low power consumption attainable by virtue of a micropower integrated circuit amplifier. (auth)

33873 TIME-STAGGERED SYSTEM FOR MULTI-COUNTER PARTICLE-GAMMA ANGULAR CORRELATION MEASUREMENTS. Mingay, D. W.; Sellschop, J. P. F.; Stemmet, M. C. (Univ. of Witwatersrand, Johannesburg). Nucl. Instrum. Methods; 82: 45-8(1970).

An angular correlation system consisting of two particle counters and two gamma counters is described in which a time-to-amplitude convertor spectrum is produced containing all the correlation data, namely, four separate particle-gamma coincidence time spectra. This allows multiple counter and therefore simultaneous multiple angle coincidence measurements to be made with a small extension to a basic two detector (one angle) coincidence system. (auth)

33874 ENERGY BALANCE METHOD FOR PULSE SHAPE DETERMINATION IN SOLID-STATE IONIZATION CHAMBER. Deshpande, R. Y. (Bhabha Atomic Research Centre, Trombay, India). Nucl. Instrum. Methods; 82: 51-3(1970).

There has been some discussion in the literature about the expression to be used for the determination of pulse shape from a solid-state ionization chamber, particularly from a p-n junction detector. In these detectors a fixed space-charge exists in the depletion region even in the absence of charge pairs produced by the incident radiation. This leads to a nonlinear rate of collection of charge. A correct expression for the rate of collection of charge in such a field is obtained from the energy balance between the rate at which the charge acquires energy, the rate at which energy is stored in the electrostatic field, and the rate at which the battery supplies it. The discrepancies in the various expressions

have been attributed to the fact that in these derivations the contribution of displacement current is not taken into account properly. (auth)

33875 SILICON DETECTOR RESPONSE FUNCTIONS TO MONOENERGETIC POSITONS. Antman, S.; Svahn, B. (Uppsala Univ.). Nucl. Instrum. Methods; 82: 24-8(1970).

Pulse height distributions from a silicon surface barrier semiconductor detector have been recorded for monoenergetic positons in the energy range 100 to 1200 keV. Corresponding distributions for monoenergetic electrons have been recorded for comparison. In addition to the well-known low energy tail and full energy peak, the analysis also revealed a high energy pulse height distribution. This effect can be attributed to the production of Compton scattered electrons from annihilation quanta interactions inside the detector. For the detector geometry used this effect represented 4% of the total number of events. The back-scattering probability for positons was deduced and compared with theoretical predictions. (auth)

33876 GAMMA SENSITIVITY OF GRANULAR AND GLASS NEUTRON SCINTILLATORS AND FILMS. Spowart, A. R. (United Kingdom Atomic Energy Authority, Thurso, Eng.). Nucl. Instrum. Methods; 82: 1-6(1970).

Following an earlier paper in this journal, the author has now measured the gamma sensitivity of granular and glass neutron scintillators using calibrated gamma sources in the energy range 0.2 to 1.25 MeV. The granular scintillators examined had varying LiF : ZnS ratios, and varied in thickness from 0.022 to 0.073 cm. The glass neutron scintillators examined contained two different levels of ^{6}Li content, and ranged in thickness from 0.1 to 0.63 cm. In addition to the above, the gamma sensitivities of various films used in conjunction with these scintillators for applications such as neutron radiography have also been measured. (auth)

33877 RESPONSE CHARACTERISTICS OF A HIGH-RESOLUTION Si(Li) PHOTON SPECTROMETER. Hollstein, M. (Kernforschungszentrum, Karlsruhe, Ger.). Nucl. Instrum. Methods; 82: 249-52(1970).

Resolution and absolute full-energy peak efficiency of a high-resolution Si(Li) spectrometer have been determined as a function of photon energy between 5 and 280 keV. The Fano factor for silicon was calculated as 0.19 ± 0.02. (auth)

33878 MULTIPARAMETER ELECTRONIC SYSTEM FOR ANALYSING AND RECORDING DATA FROM A HODOSCOPE OF SILICON SURFACE BARRIER DETECTORS. Bateman, J. E.; Mundell, J. B. (Univ. of Glasgow). Nucl. Instrum. Methods; 82: 223-9(1970).

An electronic system is described which processes the signals from a hodoscope of semiconductor detectors designed for use in pion photoproduction experiments. The principle features of the system are fast, sensitive electronic circuits for coincidence work and a flexible multiparameter data handling system capable of recording events quickly on paper tape. The particular problems of operating semiconductor detectors in the environment of an electron synchrotron are discussed in relation to the circuit designs. (auth)

33879 DIRECTIONAL-CORRELATION ATTENUATION FACTORS FOR Ge(Li) DETECTORS: A COMPARISON OF EXPERIMENTAL AND CALCULATED VALUES. Winn, W. G.; Sarantites, D. G. (Washington Univ., St. Louis). Contracts AT(11-1)-1530; AT(11-1)-1760. Nucl. Instrum. Methods; 82: 230-6(1970).

Refinements in measuring technique are utilized to improve a previously described method for experimentally determining the directional-correlation attenuation factors of Ge(Li) γ-ray detectors. Correction factors for a five-sided true coaxial 29 cm^{3} Ge(Li) detector and a five-sided trapezoidal 25 cm^{3} Ge(Li) detector are determined using this method and agree well with recently available computer calculations for these values. Various sources of error inherent in the method are discussed in some detail. (auth)

33880 SOME ANALYTICAL TECHNIQUES FOR INCREASING THE FLEXIBILITY OF THE MANGANESE BATH METHOD FOR NEUTRON SOURCE STRENGTH DETERMINATION. Scott, M. C. (Univ. of Birmingham, Eng.). Nucl. Instrum. Methods; 82: 237-44(1970).

Two methods of analyzing the results from the continuous-flow manganese bath are described, one enabling it to be used for time-varying neutron sources and the other making it possible to predict both the steady background and that due to activity present in the system initially. The results of tests on these methods are described, and the implications with regard to greater flexibility of operation are discussed. (auth)

33881 CALIBRATION AND USE OF A 5-INCH DIAMETER LITHIUM GLASS DETECTOR. Neill, J. M.; Huffman, D.; Preskitt, C. A.; Young, J. C. (Gulf General Atomic Inc., San Diego, Calif.). Contract AT(04-3)-167. Nucl. Instrum. Methods; 82: 162-72(1970).

A 5 in.-dia by 0.5 in.-thick lithium glass scintillator has been calibrated from 50 eV to 8 MeV neutron energy using the ^{10}B(n,α) and H(n,p) cross sections as standards. Monte Carlo calculations of the detector efficiency have been made and found to agree with observed values below 250 keV and to disagree above that energy. The scintillator efficiency has been found to increase at energies above 1 MeV due to detection of gamma rays from inelastic neutron scattering. The detector has been used to measure neutron spectra at intermediate energies by the time-of-flight technique. A systematic method is presented for removing background gamma rays that does not require the use of a depleted lithium glass scintillator or the use of pulse shape discrimination. (auth)

33882 GAMMA RAY POLARIMETERS WITH Ge-Li DETECTORS. Owen, G. E.; Lee, Y. K. (Johns Hopkins Univ., Baltimore). Nucl. Instrum. Methods; 82: 173-7(1970).

A planar Ge-Li detector is used in three different configurations as polarimeter. A thin planar detector by itself is found to be sensitive to linearly polarized gamma rays. A single planar detector partially sliced into three independent regions may be used as a polarimeter in two different ways. In all three cases the good resolution of Ge-Li detector is fully utilized. (auth)

33883 ON THE PROBLEM OF THE MINIMAL THRESHOLD OF A PULSE DISCRIMINATION CIRCUIT. Doolin, V. A.; Lityaev, V. M. (Inst. of Physics and Power Engineering, Obninsk, USSR). Nucl. Instrum. Methods; 82: 178-82(1970).

For a pulse-shape discriminator for comparing the fast part of the charge and the whole charge, the dispersion of the fast part of the charge pulses is calculated and measured. The minimal possible threshold of such a discriminator with a stilbene scintillator is discussed. (auth)

33884 EFFICIENCY OF PLANAR Ge(Li) DETECTORS AT VERY LOW ENERGY. Campbell, J. L.; Goble, R. J.; Smith, H. J. (Univ. of Guelph, Ont.). Nucl. Instrum. Methods; 82: 183-6(1970).

From measurements of the intensities of collimated beams of 6.4 and 14.4 keV photons in a thin-window Ge(Li) detector and a proportional counter, values of 0 to 35 Å and 0.3 μm were obtained for the depths of the absorbing layers of gold and germanium in the central region of the former. It is shown that reliable determination of the Ge(Li) detector efficiency at low energy (88.3 ± 0.3% at 6.4 keV in this case) requires precise measurement of various absorption coefficients whose tabulated values differ considerably. (auth)

33885 FURTHER NOTE ON ION IMPLANTED GERMANIUM DETECTORS. Dearnaley, G.; Hardacre, A. G. (Atomic Energy Research Establishment, Harwell, Eng.). Nucl. Instrum. Methods; 82: 187-8(1970).

This note, which might be sub-titled "Thin Window Germanium Detectors: Pride and Prejudice," is a rejoinder to that published recently by Pehl et al. in this journal, and continues the discussion of the relative merits of surface-barrier and ion implanted contacts to lithium drifted germanium particle detectors. (auth)

33886 PULSE SHAPE DISCRIMINATOR FOR X-RAY PROPORTIONAL COUNTER BACKGROUND REDUCTION. Lewyn, L. L. (Jet Propulsion Lab., Pasadena, Calif.). Nucl. Instrum. Methods; 82: 138-40(1970).

A new method for the reduction of radiation and particle background in x-ray proportional counters has been developed and tested. X-ray events leave shorter track lengths than background events depositing the same amount of energy in the counter. The charge from the x-ray event is therefore collected in a shorter period of time than the background event and the resulting current pulse is of higher amplitude. A pulse shape discriminator which compares the amplitude of the current pulse with the total charge collected in the counter is described. (auth)

33887 ERROR ESTIMATION IN NON-LINEAR LEAST SQUARES ANALYSIS OF DATA. Cline, D.; Lesser, P. M. S. (Univ. of Rochester, N. Y.). Nucl. Instrum. Methods; 82: 291-3(1970).

An incorrect procedure is frequently used, particularly in the analysis of angular correlation data, for estimating errors in quantities extracted from nonlinear least squares analysis. The correct procedure is presented. (auth)

33888 USE OF FAR-ULTRAVIOLET PHOTOMULTIPLIERS AS GAMMA-COUNTERS. Macau, J. P. (Univ., Liege). Nucl. Instrum. Methods; 82: 317-18(1970).

Two types of EMR photomultipliers were tested with gamma radiation at 1.17 to 1.33 MeV in fluxes of 1.6×10^3 to 5.8×10^6 photons/sec. Results and conclusions are presented. (W.H.K.)

33889 PULSE HEIGHT DISTRIBUTION AND THE RESPONSE OF A NaI(Tl) SCINTILLATION DETECTOR FOR MONOENERGETIC X RAY IN THE ENERGY REGION OF A FEW keV. Brunner, K.; Hink, W. (Univ., Wuerzburg, Ger.). Nucl. Instrum. Methods; 82: 269-72(1970). (In German).

The pulse height distributions of a NaI(Tl)-scintillation detector for monoenergetic x-rays of a few keV were compared with the calculations of Prescott. Good agreement was achieved except for quantum-energies near the iodine-L-absorption edges. In this region the relative variance of the distributions no longer showed a linear dependence on the reciprocal mean pulse height but a structure caused by the different absorption processes under and above the L-edges. A similar structure was observed in the response of the detector (mean pulse height/energy). This behavior shows that the photon distribution in the scintillation crystal near the L-edges is strongly affected by the quantum energy and cannot be described by a Poisson distribution. (auth)

33890 PORTABLE RADIATION MONITOR WITH LINEAR OR LOGARITHMIC OUTPUT. Splichal, W. F. Jr. (E. I. du Pont de Nemours and Co., Aiken, S. C.). Contract AT(07-2)-1. Nucl. Instrum. Methods; 82: 307-9(1970).

A portable semiquantitative radiation monitor was developed for GM, scintillation, and proportional detectors that provides either logarithmic or linear output. (auth)

33891 CAVITATION NUCLEATED BY $^{10}B(n,\alpha)^7Li$. Greenspan, M.; Tschiegg, C. E. (National Bureau of Standards, Washington, D. C.). Nucl. Instrum. Methods; 82: 310-12(1970).

Acoustic cavitation has been nucleated on the reaction $^{10}B(n,\alpha)^7Li$ in methanol solution. Implications for a slow neutron detector or counter are discussed. (auth)

33892 DEVELOPMENTS IN NUCLEAR INSTRUMENTATION. Lloyd, T. L. (Oxford Univ.). Phys. Bull. (London); 21: 203-4 (May 1970).

Recent developments of various detectors used in the nuclear field are discussed. The large and position sensitive types of semiconductor devices are examined in relation to requirements. The Charpak chamber, designed to detect ionizing particles and to measure their trajectories and ionizing power is described. To obtain an image a streamer chamber may be used in which paths of particles are made self-luminous or, combined with a Wilson cloud chamber, the tracks are bright and persistent enough to be fed via a television camera straight onto magnetic tape. To differentiate between particles, two counters have recently been developed, one by Yual et al.(1969) measures the transition radiation emitted when a fast charged particle emerges from one medium into another of different dielectric constant. The other device (Lorikyan 1968) measures δ-ray production in thin foils. It is suggested that much development work is still to be done. (UK).

33893 CYLINDRICAL PLASTIC SCINTILLATORS FOR MONITORING BETA-GAMMA-ACTIVITY IN AIR AND WATER. Barz, Harry G.; Jacobi, Wolfgang (Hahn-Meitner-Institut fuer Kernforschung, Berlin). Health Phys.; 18: 659-64(Jun 1970).

β-sensitive plastic scintillator detectors are described, which were developed for the monitoring of fission products and ^{41}Ar in effluent ducts from a nuclear reactor. The detector consists of a tubular plastic scintillator of 5 mm wall thickness, which is drawn up on a cylinder of light conducting material. The main detector properties as a function of the scintillator length are described. The detection limit for $^{90}Sr + ^{90}Y$ is below the MPC-value recommended by ICRP. Compared with GM-counters of the same size the detectors have the advantage to allow monitoring at high pressure load and high counting rate. (auth) (UK)

33894 MULTISCALER. Manifesto, H. D.; D'Aquila, R. D. (Comision Nacional de Energia Atomica, Buenos Aires). Acta Cient.; 2: 97-101(Apr-Sep 1969). (In Spanish).

A fully transistorized instrument to measure radioactivity and its rate of change from radioactive subtances of very short mean life, has been developed. As a memory, twenty elements formed by a sixteen by sixteen ferrite nucleus are used. Readout is provided by a cathode ray tube; it has been planned to later attach a memory data printer. (auth)

33895 POST-DETECTOR FILTERING IN RADIOMETRY. Cooper, B. F. C. (Commonwealth Scientific and Industrial Research Organization, Epping, Australia). Inst. Radio Electron. Eng., Aust., Proc.; 31: 41-8(Feb 1970).

The characteristics of a number of analog and digital low-pass filters are considered from the viewpoint of radiometric post-detector filtering. The analog filters treated are the simple RC time-constant and the general second-order filter. Their effects on gaussian-shaped and sinusoidal inputs are compared. Sampling and pre-filtering requirements for digital filters are reviewed and desirable characteristics for weighting functions used for digital smoothing are discussed. (Australia)

33896 NEW INSTRUMENTATION FOR POSITRON SCANNING. Burnham, C. A.; Aronow, S.; Brownell, G. L. (Massachusetts General Hospital, Boston). pp 16-19 of Radioactive Isotopes in the Localization of Tumours. /McCready, V. R. (ed.). London; William Heinemann Medical Books Ltd. (1969).

From Symposium on Radioactive Isotopes in the Localization of Tumours, London, England. See CONF-670948.

In the process of positron annihilation, two quanta are emitted simultaneously and back-to-back. These properties can be used to extract positional information with high efficiency. In principle, all of the annihilation pairs could be detected in a positron system. This paper deals with the problems encountered in positron systems, new techniques for positron scanning, and the future potential of such systems. (UK)

33897 DESIGN AND PERFORMANCE OF THE DYNAPIX. Hindel, R. (Intertech Inc., North Haven, Conn.); Gilson, A. J.; Swanson, L. pp 20-5 of Radioactive Isotopes in the Localization of Tumours. /McCready, V. R. (ed.). London; William Heinemann Medical Books Ltd. (1969).

From Symposium on Radioactive Isotopes in the Localization of Tumours, London, England. See CONF-670948.

This paper describes the design and performance of the Dynapix, a 10-channel scintillation scanner. Two considerations have governed the design: improvement of sensitivity while retaining good depth response; and improvement of data handling, both with respect to display and digital data storage. Particular features of this instrument are as follows: rapid performance of scans; recording of all scanning information on magnetic tapes for nondestructive replay; use for dynamic function measurements; and because information is recorded quantitatively, the instrument can be used with computer techniques. (UK)

33898 EVALUATION OF AN IMAGE INTENSIFIER ISOTOPE CAMERA. Ter-Pogossian, M. M. (Washington Univ., St. Louis). pp 43-5 of Radioactive Isotopes in the Localization of Tumours. /McCready, V. R. (ed.). London; William Heinemann Medical Books Ltd. (1969).

From Symposium on Radioactive Isotopes in the Localization of Tumours, London, England. See CONF-670948.

A brief description is given of an isotope camera based on the use of an image intensifier tube. The instrument was developed in cooperation with the Picker X-ray company. The main advantages are: high resolution; capability of handling information rapidly; contrast control capability; and simplicity of design. The main disadvantages are: absence of pulse height discrimination; usefulness limited to X or gamma-ray photons with an energy lower than 200 keV; data presentation only in qualitative form; and limitation of the useful field to approximately 20 cm. The camera was tested clinically in static (brain and thyroid gland) and dynamic studies (brain, heart, and kidney). (UK)

33899 VERSATILE INSTRUMENT FOR PHOTOSCAN ANALYSIS WHICH PRODUCES COLOUR DISPLAY FROM BLACK AND WHITE PHOTOSCANS. Charleston, D. B.; Beck, R. N.; Wood, J. C.; Yasillo, N. J. (Argonne Cancer Research Hospital, Chicago). pp 56-7 of Radioactive Isotopes in the Localization of Tumours. /McCready, V. R. (ed.). London; William Heinemann Medical Books Ltd. (1969).

From Symposium on Radioactive Isotopes in the Localization of Tumours, London, England. See CONF-670948.

The system makes use of a cathode ray tube to generate a very short persistence spot which is focused by a lens on to a plane which holds a photoscan transparency. The light transmitted through the negative is collected by another lens and projected on to the photocathode of a photomultiplier tube. The voltage output of this tube can be processed electronically in many ways before it is presented for display to a color television set synchronized with the flying-spot cathode ray tube. (UK)

33900 SPARK CHAMBERS AND IMAGE INTENSIFIERS. Kellershohn, C.; Lansiart, A. (Commissariat a l'Energie Atomique, Paris). pp 58-62 of Radioactive Isotopes in the Localization of Tumours. /McCready, V. R. (ed.). London; William Heinemann Medical Books Ltd. (1969).

From Symposium on Radioactive Isotopes in the Localization of Tumours, London, England. See CONF-670948.

At the time of writing the paper, the spark chamber was a simple device limited in scope to the uses of iodine 125 and to some extent those of Hg 197, i.e., morphological examination of the thy-

roid, and to a lesser degree the kidney, and to study low energy gamma emitter metabolism of infants and small animals. The image intensifier described was successfully used with a gamma camera for thyroid studies using technetium. The instrument was also successfully used for demonstrating a radioactive embolus traveling through the cardiac cavities, the pulmonary system and the large arteries. (UK)

33901 RESOLVING CAPABILITY OF PHOTOSENSITIVE LAYERS IN AUTORADIOGRAPHY WITH TRITIUM. Kortukov, E. V. (Moscow State Medical Inst.). Zh. Nauch. Prikl. Fotogr. Kinematogr.; 14: 319-23(Sep-Oct 1969). (In Russian).

The resolving capability in tritium autoradiography with radiation energies in the range 0-18.6 keV is considered. The case of a point source which is a definite distance from a layer of silver halide crystals is examined. The calculations took into account the self-absorption of radiation, the screening of internal layers, and the angular distributions of scattered electrons. The range of resolution comparable to the dimensions of a silver halide crystal was established, and a formula for estimating resolution capability in tritium autoradiography is given. (tr-auth)

33902 IMPROVEMENTS IN OR RELATING TO DETECTORS FOR PENETRATING RADIATION. Browning, George William (to Associated Electrical Industries Ltd.). British Patent 1,192,652. 20 May 1970. Filed 31 Jan 1968.

Reference is made to detectors of the gas counter-type for γ-rays, x-rays and charged particles. Conventionally, in such detectors the current pulses are passed from a central collector to indicating apparatus through a decoupling condenser which must withstand high potential and at the same time avoid micro-discharges which could give rise to spurious pulses. Such condensers are expensive and bulky. Furthermore, in detectors of this type in which the gas is continuously streamed, small particles of dirt are liable to accumulate on the electrodes and affect performance, and it is necessary to clean the interior frequently. The detector described avoids these disadvantages to an appreciable extent. It comprises a collector wire, substantially at earth potential, extending through an ionization chamber in the form of a tubular metal casing which is at a high potential; the casing is split longitudinally into separable sections, and is enclosed in an insulating block. The collector wire extends axially within the casing between spring supports, insulated at each end from the casing and the construction is such that the casing may be removed longitudinally from the insulating block and the sections then separated to provide access to the collector wire. The system described also includes x-ray analyser apparatus or other apparatus such as γ- or β-spectrometers, including a detector of the type described. (UK)

33903 POLYPROPYLENE-WINDOW PROPORTIONAL COUNTER FOR THE COSMIC SOFT X-RAY MEASUREMENT. Hayakawa, Satio; Kato, Takako; Makino, Fumiyoshi; Ogawa, Hideo; Tanaka, Yasuo; Yamashita, Koujun (Nagoya Univ., Japan). Jap. J. Appl. Phys.; 9: 542-6(May 1970).

Polypropylene-window proportional counters have been developed and successfully flown on board a sounding rocket for the soft x-ray measurement. Biaxially-oriented thin polypropylene film is found to have remarkable strength and particular advantage in the transmission of soft x-rays, for this material is composed of only carbon and hydrogen. The four-micron thick film which was used transmits 43% of the fluorescent K x-rays of carbon (0.28 KeV) and 79% of K x-rays of aluminium (1.49 KeV). (auth)

33904 DISCRIMINATING DEVELOPMENT OF CHARGED-PARTICLE TRACKS IN NUCLEAR EMULSIONS. I. AMIDOL AND NaSCN DEVELOPER PROPERTIES. Haseganu, D. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys.; 15: 99-105(1970).

Dealing with the discriminating development by means of Amidol and NaSCN developers, this paper aims at obtaining some quantitative measurements of the discriminating power of this kind of developers. The variation of the developer activity with respect to NaSCN concentration was also investigated. Measurements of ranges and lacunarity were performed and gap length distributions obtained from which the Fowler Perkins parameters were estimated. (auth)

33905 PROGRAM FOR STUDYING THE SPACE RELIABILITY OF LOW-ENERGY DETECTORS. Barat, C.; Bosqued, J. M. (CESR, Toulouse). pp 229-42 of Calcul des Doses de Radiations dans l'Espace. Elbaz, C. (ed.). Toulouse; Comptes Rendus de Journees Europeennes (1968). (In French).

From Calculation of Radiation Doses in Space Conference, Toulouse, France. See CONF-680219.

Charged particles of low energy (1 eV to 100 keV) are important, accounting for the Sun-Earth relationships and precipitation in the Earth vicinity. The detection of these low-energy particles is cut off by the presence of a shielding material surrounding the sensitive part of the detector. The secondary emission phenomena are used for detection. With the electron multiplier without window, the threshold of detection for charged particles is 100 eV. However, the characteristics of this detector as a function of time and irradiation are not very well known, so it was necessary to carry out its reliability survey before using it in flight. Physical conditions of space environment were successively simulated to study thirty multipliers in normal continuous operation during six months. Physical and electrical characteristics of these samples were measured in identical conditions, before and after the tests of reliability. The results will bring technological improvements for future detectors. Systematic studies of secondary emission layers should lead to a decrease in the detector threshold down to 10 eV. (auth)

33906 RECENT IMPROVEMENTS IN THE APPLICATION OF IMAGE INTENSIFIERS TO RADIONUCLIDE IMAGING IN NUCLEAR MEDICINE. Beierwaltes, William H. (Univ. of Michigan, Ann Arbor); Thomas, F. Deaver; Colestock, Harry E.; Colvin, Ted H. pp 2.C.4.1-9 of Conference Record. Portland, Oreg.; Institute of Electrical and Electronics Engineers (1968).

From 6th IEEE Region Conference, Portland, Oreg. See CONF-680502.

An image intensifier type camera is described which is used for the production of radionuclide images in nuclear medicine. Recent system improvements to lower system noise and improve sensitivity and resolution are delineated. Further possible system improvements are suggested which may eventually make this a useful clinical tool. (auth)

33907 NEUTRON DOSIMETRY BY SEMICONDUCTOR DETECTORS AND HYDROGENOUS RADIATOR ASSEMBLY. Deme, S. (Central Research Inst. for Physics, Budapest). Health Phys.; 18: 705-10(Jun 1970).

Two methods of applying semiconductor diodes to neutron dosimetry have been studied. In the first an homogeneous polyethylene radiator and a fully depleted semiconductor detector of dE/dx type were used and the dose in rad units was calculated from the proton spectrum obtained in the semiconductor detector. In the second the protons emerging from a multilayer, sandwiched polyethylene-aluminum radiator were counted by a semiconductor detector. The structure of the radiator was such that the dose in rad was characterized by the number of protons emerging with an energy above a given threshold. The energy dependence and accuracy of both methods were determined by calculation and direct measurement. It was found that both methods are suitable for measuring to $\pm 10\%$ accuracy collimated neutron beams in the energy interval from 0.5 to 10 MeV with neutron intensities higher than a few rad/hr. (auth) (UK)

33908 COMPUTER PROGRAM FOR EVALUATING THE PERFORMANCE OF FOCUSSED COLLIMATORS. Tsialas, S. P.; Lewis, B. (International Atomic Energy Agency, Vienna). Int. J. Appl. Radiat. Isotop.; 21: 375-7(Jun 1970).

The three fundamental properties of focused collimators for scintigraphy, the plane-source sensitivity, the spatial resolution and the septum penetration fraction for a given γ-ray energy, can be derived from a set of line-source measurements in air (NSA 22:6699). Data for a variety of commercially available collimators based on line-source measurements have been reported (Medical Radioisotope Scintigraphy, Vol. 1 p 389 I.A.E.A. Vienna 1969). Such a large number of data can be handled efficiently only with the aid of computer facilities. A FORTRAN IV computer program, COLSCI, has been written to give the fundamental properties of focused collimators from such line-source data and is available from the IAEA computer section. (UK)

33909 DETERGENT CONTAMINATION OF A LOW LEVEL COUNTER. Carmi, I. (Weizmann Inst. of Science, Rehovoth, Israel). Int. J. Appl. Radiat. Isotop.; 21: 377-8(Jun 1970).

Cleaning the copper cathode of a low level proportional counter by boiling in a detergent solution (detex-11) raised the normal anticoincidence background count from 14.10 cpm to 62.50 cpm. The contamination was removed by boiling in distilled water and ordinary household detergent followed by immersion in concentrated hydrochloric acid and finally by etching the cathode with fuming nitric acid. The contamination was found, by γ-ray spectrometry, to be due to the ^{40}K content of the detergent. (UK)

33910 MEASUREMENT OF THE ACTIVITY OF PHOSPHORUS IN SAMPLES OF BIOLOGICAL ORIGIN BY MEANS OF CHERENKOV RADIATION. Sipos, Domokos; Koch, Lehelne. Atomtech. Tajek.; 12: 313-15(Sep-Oct 1969). (In Hungarian).

Determination of the activity of ^{32}P which is widely used as a tracer in agrochemical measurements, presents difficulties because the specific activities are usually very low. The Cherenkov radiation which yields a light emission with a wave length of 3000 to 7000 Å at a lower energy threshold of 260 keV in aqueous solutions, was used for these measurements on the basis of V. K. Haber's data, with and without addition of PPO to the water. The method was found to be economical because it requires only small amounts of reagents and eliminates tedious manipulations. After the measurements the specimens still may be used for carrying out chemical analyses. The experimental error may be reduced by using a carrier; addition of phosphoric acid prevents the freezing of the solution. A small amount of the specimen is sufficient for the determination by this method. (TTT)

33911 NUCLEAR ELECTRONICS. Kowalski, E. New York; Springer-Verlag New York, Inc. (1970). 410p. $26.40.

Electronics for radiation detectors and signal processing is studied. Topics include radiation detectors and related circuits, analog circuits, analog-to-digital converters, evaluation of the time information, digital circuits, and data processing. (918 references) (W.H.K.)

33912 LOW-LEVEL COUNTING BY LIQUID SCINTILLATION. II. APPLICATIONS OF EMULSIONS IN TRITIUM COUNTING. Lieberman, Robert (Southeastern Radiological Health Lab., Montgomery, Ala.); Moghissi, A. A. Int. J. Appl. Radiat. Isotop.; 21: 319-27(Jun 1970).

The evaluation of numerous detergents for application in low-level liquid scintillation counting of tritium in an emulsion system is presented. In a typical operating mode of the selected system having a background of 9 counts/min, one count/min above background corresponds to 200 pCi/l. of water. This increased sensitivity is achieved by the application of a new detergent Triton N101. The described system is stable and reproducible. (auth) (UK)

33913 DIVERGING COLLIMATOR. Hisada, Kin-ichi; Matsudaira, Masamichi (Kanazawa Univ. Hospital, Japan). Radioisotopes (Tokyo); 19: 263-6(Jun 1970). (In Japanese).

By using the diverging collimator developed by Nuclear-Chicago Corporation together with the scintillation camera, it has been possible to take the entire image of both the lungs as well as both the liver and spleen in a single field of view. When the diverging collimator is used, the loss of intrinsic resolution may occur theoretically, due to inclination of the incidence angle of γ-photon to the scintillation crystal. However the result of experiments using a line-source phantom showed only the negligible loss of intrinsic resolution. Also over-all resolution including geometric resolution was not deteriorated. The image of the scintiphoto taken with the diverging collimator, however, revealed distinct distortion in the depth direction when it was examined using a zigzag line phantom. This image distortion does not drastically disturb qualitative interpretation of scinti-image but may bring up a problem when quantitative analysis of scinti-image is desired in the future. The over-all sensitivity of the scintillation camera dropped to one-half or one-third when the diverging collimator is used. (auth)

Nuclear Spectroscopic Instrumentation

33914 (AD-698558) HIGH-RESOLUTION GAMMA-RAY SPECTROSCOPY STUDY. Annual Report. Imhof, W. L. (Lockheed Missiles and Space Co., Sunnyvale, Calif.). 31 Dec 1969. Contract N00014-69-C-0372. 21p. (LMSC-695167). CFSTI.

The basic objective of the program is to study methods by which nuclear debris measurements can be made more extensive and interpretable through utilization of important new advances in high-resolution gamma-ray spectroscopy. The program focussed on two principal areas: (1) a laboratory program to investigate, for selected weapons materials, the fission product gamma-ray spectra obtained under various conditions and (2) a study of the utility and feasibility of using Ge (Li) detectors on satellites to obtain diagnostic information on nuclear weapons detonated in the atmosphere or at high altitudes. The preliminary survey laboratory measurements of the gamma rays emitted from neutron induced fission fragments have been completed. On the basis of the preliminary laboratory measurements, estimates have been made of the responses expected in space and a proposed experiment has evolved for conducting a proper evaluation of the operational model. These various activities are briefly reviewed in the report. (auth) (USGRDR)

33915 (AERE-R-6246) THE DIDO (6H) LONG WAVELENGTH INELASTIC NEUTRON SPECTROMETER. Bunce, L. J.; Harris, D. H. C.; Stirling, G. C. (Atomic Energy Research Establishment, Harwell (England)). Apr 1970. 25p. Dep. CFSTI (U. S. Sales Only). UK 4s. 6d.

A new long wavelength neutron time-of-flight spectrometer has been constructed, optimized for inelastic neutron scattering studies in chemistry. A cooled beryllium filter is used to select neutrons with wavelengths greater than 4 Å from an ambient source in the reactor. Monoenergetic neutron bursts, produced by a pair of phased rotors, are scattered by the sample and detected in a large bank of BF_3 counters covering nine different angles. The flight time of the scattered neutrons is measured, and the counts accumulated, in a small on-line computer system. (auth)

33916 (HASL-230) NUCLEAR EMULSION SPECTROMETRY AT LOW AND INTERMEDIATE NEUTRON ENERGIES (AN UPDATING OF HASL-162). Sanna, Robert S.; McLaughlin, James E.; O'Brien, Keran (New York Operations Office (AEC), N. Y. Health and Safety Lab.). Jun 1970. 53p. Dep. CFSTI.

Improvements and changes in techniques for using nuclear track emulsions as neutron spectrometers are described. Emulsion development procedures, necessary data corrections, control of scanning errors, error propagation, and the analyses used to infer the neutron spectra are summarized. To test the spectrometric system, pseudo-proton track data were generated from a $^{239}PuBe$ spectrum by a Monte Carlo technique and used to produce a neutron spectrum for comparison with the original spectrum. Spectra from real measurements are presented. (auth)

33917 (JINR-P10-5043) SOLUTION OF A NONLINEAR PROBLEM OF GAMMA SPECTROSCOPY BY NEWTON METHOD USING SMOOTHING OF LINEAR STEPS. Gadzhokov, V.; Aleksandrov, L.; Stoyanov, Ch. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1970. 10p. (In Russian). Dep. CFSTI (U. S. Sales Only).

Solution of a non-linear physical problem by the Newton method using smoothing of linear steps is presented. An illustrating example is given with the initial data, and the solution obtained by the method suggested is included. (auth)

33918 (RD/B/N-1416) NEUTRON FLUX SPECTROMETER WITH NEARLY CONSTANT SENSITIVITY OVER THE ENERGY RANGE THERMAL TO 14 MeV. Longworth, J. P. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). Mar 1970. 38p. Dep. CFSTI (U. S. Sales Only).

A neutron flux spectrometer, whose sensitivity varies by a factor of only 2.7 over the energy range thermal to 14 MeV, is described. The DELTA (Density of Linear Thermalization) spectrometer consists of LiF thermal neutron detectors spaced at intervals along the axis of a cylindrical moderator and is a directional device. The theoretical best resolution of the spectrometer varies from some 12% at low energies to about 5% at 10 MeV when the measured thermal neutron flux is known to ±2%. The basic principles and detailed manufacture of the DELTA neutron spectrometer, the method of its experimental and theoretical calibration, and the final response matrix are described. (auth) (UK)

33919 ON THE EVALUATION OF RELIABLE PARAMETERS FOR THE DESCRIPTION AND DESIGN OF FLAT SPECTROMETERS. Groth, T. (Uppsala Univ.). Nucl. Instrum. Methods; 82: 93-105(1970).

Flat spectrometers are customarily described by the radial variation of the field intensity in the plane of symmetry: $B_z(r,0) = B_0 \sum_{n=0}^{\infty} a_n[(r - r_0)/r_0]^n$. The usefulness of the expansion coefficients a_n in the design of a spectrometer is highly dependent on the reliability of these coefficients as descriptive parameters. The successful application of Chebyshev approximation methods to the problem of evaluating reliable coefficients is reported and the shortcomings of commonly used standard procedures are also pointed out. The methods are applied to the optimum field giving 12 expansion coefficients, the first seven of which coincide with those theoretically derived by Lee-Whiting and Taylor. (auth)

33920 FAST NEUTRON SPECTROMETRY WITH IDENTIFICATION OF RECOIL PROTONS. Cambiaghi, M.; Fossati, F.; Pinelli, T. (Univ., Pavia, Italy. Istituto Nazionale di Fisica Nucleare, Pavia, Italy). Nucl. Instrum. Methods; 82: 106-8 (1970).

A neutron spectrometer, based both on the identification and the energy measurement of recoiling protons from a hydrogenous radiator, has been developed. The performance of such an apparatus is characterized by a large energy range (from 100 keV to 25 MeV), a satisfactory energy resolution (about 100 keV) and an effective discrimination of the background whose frequency can reach an order of magnitude higher than that relative to the events to be considered. (auth)

33921 IMPROVEMENTS OF A DOUBLE FOCUSSING IRON-CORE SPECTROMETER FOR HIGH RESOLUTION COINCIDENCE

AND ANGULAR CORRELATION MEASUREMENTS. Antman, S.; Grunditz, Y.; Johansson, A.; Nyman, B.; Pettersson, H.; Svahn, B.; Siegbahn, K. (Uppsala Univ.). Nucl. Instrum. Methods; 82: 13-23(1970).

A 50 cm radius iron-core double focusing beta-ray spectrometer has been equipped with a gamma-ray coincidence arrangement, which can provide measurements of electron-gamma coincidences and angular correlations at high resolution in the electron channel. A special beta-ray spectrometer detector system, employing coincidences between positons and the subsequent annihilation quanta, has been constructed. The natural background of this system is about 1 count/hour, which permits studies of extremely low intensity positon distributions. The isoaberration curves of the beta-ray spectrometer have been measured and from these results optimized shapes of the baffles were constructed. The magnetic field of the spectrometer is measured with a "magnetic stripping" system which is described as is also the automatized demagnetization unit. (auth)

33922 CONSTRUCTION AND APPLICATION OF A $\pi\sqrt{(13)}/2$ HIGH-RESOLUTION β-RAY SPECTROMETER CONNECTED WITH A TANDEM ACCELERATOR. Daniel, H.; Jahn, P.; Kuntze, M.; Martin, B. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Nucl. Instrum. Methods; 82: 29-44(1970).

A high-resolution iron-free β-ray spectrometer with a focusing angle of $\pi\sqrt{(13)}/2 = 324.5°$ has been constructed and connected with a 6 MV tandem accelerator. The focusing principle of this "flat" spectrometer involves radial focusing and axial defocusing at the exit slit which is curved. The "image" of a point source is a curved line, and the image of a line source is identical with that of a point source. The extra degrees of freedom due to this focusing principle are used to obtain a resolving width independent of all aperture angle terms up to the third power, and the only fourth-order term is that with $\varphi_r^2 \times \varphi_z^2$ (φ_r and φ_z are radial and axial aperture angles, respectively). The dispersion is D = 6.5. The stationary orbit has a radius of $r_0 = 30$ cm. The magnetic field is produced by five pairs of coils. The maximum electron energy is 4.5 MeV and the corresponding electric power 45 kW. A typical pair of values for resolution (fwhm) η and fractional solid angle ω is $\eta = 2.2 \times 10^{-4}$ and $\omega = 0.6 \times 10^{-2}$. The spectrometer is situated in an iron-free brick building nearby a 6 MV tandem accelerator whose beam can be focused at the source position of the spectrometer to a spot of 0.5×5 mm^2. The spectrometer was widely applied to study conversion line energies and intensities both from radioactive sources and from Coulomb-excited nuclei. At favorite cases momentum ratios can be measured with 2×10^{-6} precision (internal error), and intensity ratios with 1%. Results are mostly given for energy values. (auth)

33923 RESOLUTION OF A SOLID STATE FISSION FRAGMENT MASS SPECTROMETER. Higbie, J. (Neutron Physics Lab., Studsvik, Sweden). Nucl. Instrum. Methods; 82: 253-8 (1970).

The resolution of a fission fragment mass spectrometer using two, heavy ion, surface barrier, silicon detectors is investigated. The mass assignment is made on the basis of the detector pulse heights. The average initial fragment mass and the initial mass resolution are calculated as a function of the measured (apparent) mass for three different thicknesses of the fissile material deposit. This treatment gives a clear indication of those factors most important for good mass resolution work. (auth)

33924 DETAILED EVALUATION OF THE MECHANICAL CORRELATION CHOPPER FOR NEUTRON TIME-OF-FLIGHT SPECTROMETRY. Price, D. L.; Skoeld, K. (Argonne National Lab., Ill.). Nucl. Instrum. Methods; 82: 208-22(1970).

The statistical efficiency of the conventional single burst thermal neutron chopper system is compared to the statistical efficiency of a novel multiburst system. It is shown that the multiburst system is always superior to the conventional system in applications where the signal-to-noise ratio is low. In the absence of noise the multiburst system will be better only for channels in which the total count is twice the average signal per channel. These conditions are discussed with reference to existing data from conventional systems. Optimal operating parameters for the two systems are derived. The analysis is extended to measurements of areas and second moments of peaks occupying a number of channels. Instantaneous pulsing systems are briefly considered in the same formalism. (auth)

33925 AUTOMATIC LOCATION AND AREA DETERMINATION OF PHOTOPEAKS. Connelly, A. L.; Black, W. W. (Idaho Nuclear Corp., Idaho Falls). Nucl. Instrum. Methods; 82: 141-8(1970).

In an earlier paper a method of isolating structure in gamma-ray, x-ray and neutron spectra via use of a windowed cross-correlation function was shown. The method is of a general nature, i.e., it is independent of the source of the spectrum analyzed. This paper consists first of a mathematical elaboration of the earlier paper, and second, a method is developed for determining the raw area of the peaks in a spectrum under specified conditions with an error less than 15%. (auth)

33926 NEUTRON SPECTROMETRY IN THE ENERGY RANGE 1 TO 100 keV USING THE ^{6}Li SANDWICH SPECTROMETER. Rickard, I. C. (Imperial Coll. of Science and Tech., London). Nucl. Instrum. Methods; 82: 287-8(1970).

Two methods of utilizing the ^{6}Li solid-state sandwich detector in the energy range 1 to 100 keV are compared and contrasted. (auth)

33927 EXPANSION METHOD TO UNFOLD PROTON RECOIL SPECTRA. Kockum, J. (Aktiebolaget Atomenergi, Studsvik, Sweden). Nucl. Instrum. Methods; 82: 285-6(1970).

The recoil spectrum is unfolded by expanding the neutron spectrum as a product of the derivative of the recoil spectrum and a power series, the coefficients of which are determined by a least squares fit. (auth)

33928 FACTORS DETERMINING THE ULTIMATE DETECTION SENSITIVITY OF Ge(Li) GAMMA-RAY SPECTROMETERS. Cooper, J. A. (Battelle Memorial Inst., Richland, Wash.). Contract AT(45-1)-1830. Nucl. Instrum. Methods; 82: 273-7 (1970).

An equation is derived which relates the peak detection sensitivity of Ge(Li) gamma-ray spectrometers to their efficiency, resolution and background interference. A figure-of-merit is derived which is directly related to the detector's sensitivity and a procedure is suggested for comparing the quality of various Ge(Li) spectrometers. These relations are discussed relative to state-of-the-art detector systems and applied to several detectors. A method for calculating the spectrometer's sensitivity from the detector's dimensional parameters is suggested. (auth)

33929 EFFECT OF ABSORBERS ON ALPHA SPECTRAL MEASUREMENTS. Peshori, L. H.; Nambiar, P. P. V. J.; Gopinath, D. V. (Bhabha Atomic Research Centre, Trombay, India). Health Phys.; 18: 685-91(Jun 1970).

An analytical expression for the response function of an alpha particle detecting system is described. The spectral spread has been assumed to be due to detector resolution and absorber between the source and detector. The counts in channel E′ are given by $C(E') = \int F(E)g(E - E')\,dE$ where $g(E - E')$ is the gaussian distribution due to detector resolution. F(E), the spectrum of alpha particles incident on the detector after traversing a distance ρ, is obtained from the expression $1 - (\rho/R) = (E/E_0)^\eta$ where R is the range and E_0 initial energy of the particles. η is not too sensitive a function of energy. Experimental spectra for ^{234}U and ^{241}Am obtained with a surface barrier detector are compared with the spectra computed with the above response function. It is observed that $\eta = 1.60$ gives good agreement between theory and experiment for ^{234}U and $\eta = 1.68$ for ^{241}Am. (auth) (UK)

33930 SIMPLE METHOD FOR DETERMINING THE MAXIMUM ENERGY OF BETA EMITTERS BY ABSORPTION MEASUREMENTS. Baltakmens, T. (National Radiation Lab., Christchurch, N. Z.). Nucl. Instrum. Methods; 82: 264-8 (1970).

A simple method for determining the maximum energy of a beta emitter by absorption measurements is presented. Absorbers of two different metals, e.g., aluminum and copper, are used in combination. Two readings only are required for each sample. The method is particularly suited to low activity samples. The relationship between absorption coefficient, maximum energy, counting geometry and counter characteristics is discussed. (auth)

33931 POSSIBLE LOSS OF INFORMATION IN DETERMINING HALF LIVES VERSUS OPTIMALISATION IN THE SEARCH OF ISOMERIC TRANSITIONS. Fleck, C. M.; Harms, J.; Niederstaetter, W.; Seiwerth, H. (Oesterreichische Hochschule, Vienna). Nucl. Instrum. Methods; 82: 325-6(1970).

A method for measuring half lives in the range of μsec to msec using repeated pulse height analysis during successive time intervals in connection with pulsed activation is reviewed. This method is compared to the standard method of time analysis and checked for a possible loss of information. If transitions are measured whose energy is not known beforehand the method of successive pulse height analysis may be preferred, trading some loss of accuracy of the half life against the advantage of simultaneously finding and measuring the photo-peak of the transition. (auth)

33932 ABSOLUTE DETERMINATION OF THE DISINTEGRATION RATE OF A RADIOACTIVE NUCLIDE WITH A COM-

PLEX DECAY SCHEME BY $\beta-\gamma$- AND THE $4\pi\beta-\gamma$ COINCIDENCE METHOD. Schoenfeld, E. (Deutsches Amt fuer Messwessen und Warenpruefung, Berlin). Nucl. Instrum. Methods; 82: 198-204 (1970). (In German).

If the absolute disintegration rate of a radioactive source with noticeable self absorption containing a nuclide with a complex decay scheme shall be determined with the coincidence method, a correction must be applied which takes into account the branching ratios of the decay scheme, the conversion of the gamma lines, the different self absorption for particles of different β-spectra, and the efficiencies for all particles and γ-rays reached at the special energy discrimination levels. A method is given which allows to derive the decay scheme correction factor μ_s in the relation $N_0 = \mu_s N_0^*$ (N_0^* = uncorrected disintegration rate) from theoretical considerations for several nuclides. This method is demonstrated in the case of ^{198}Au. For 10 μm thick gold foils μ_s has been calculated in the cases of a $4\pi\beta-\gamma$- ($\epsilon_\beta = 0.76$) and a simple $\beta-\gamma$-coincidence equipment with a plastic β-scintillator (β-discrimination level 250 keV, $\epsilon_\beta = 0.25$). Results are given and compared with that of extrapolation measurements. (auth)

33933 COUNTING QUENCHED LIQUID SCINTILLATION SAMPLES USING AN OUTSIDE-THE-INSTRUMENT GAMMA SOURCE AND AN EXTERNAL STANDARD CHANNELS RATIO METHOD. Takahashi, I. T.; Blanchard, F. A. (Dow Chemical Co., Midland, Mich.). Anal. Biochem.; 35: 411-23(Jun 1970).

Interest in external standardization has increased since 1964, when manufacturers began incorporating an external source into their counting equipment. New instruments are now available which are equipped with two or three individually adjustable counting channels and two separate external standard channels so that the ratio method can be used to assay one, two, or three different isotopes simultaneously. The development of computer programs and other automated computation methods for handling the counting data has increased the use of the external standard method, especially for assaying large numbers of low level samples. We have used the technique to determine the background counts of quenched samples. Since 1965, we have been using an external standard channels ratio method to determine the counting efficiency of many of our quenched samples. This paper describes the procedure developed for our three-channel spectrometer, which is not equipped with a built-in external source. No special hardware or modification of the spectrometer is required for this technique. For a given instrument and source, the detailed calibration described here is needed just once. The settings obtained for the source windows can then be used for a wide variety of samples. This procedure should be adaptable to most such instruments. (auth)

33934 NEUTRON SPECTRUM OF THE RADIOACTIVE Be (α,n) SOURCE IN THE ENERGY REGION BELOW 1 MeV. Zill, H. (Physikalisch-Technische Bundesanstalt, Brunswick). Z. Naturforsch., 24a: 1287-9(Aug. 1969). (In German).

A proportional counter is described for the measurement of recoil protons produced in methane gas by neutrons with energies below 1 MeV. The special electronic equipment for counting is described. Neutron sources of ^{241}Am-α-Be and Ra-α-Be were used. The spectra obtained with these sources below 1 MeV are presented in diagrams. (H.B.G.)

High Energy Physics Instrumentation

33935 (SLAC-PUB-752) STATUS OF HUMMINGBIRD FILM DIGITIZERS. Brown, John L. (Stanford Linear Accelerator Center, Calif.). May 1970. 17p. (CONF-700519-1). Dep. CFSTI.

From 2nd International Colloquium on PEPR, Cambridge, Mass.

The status of CRT film digitizers at SLAC is briefly reviewed. The hardware and computer configuration are described including the IBM 360/91, Hummingbird II, and Hummingbird III with tv display. Experience with the system on three experiments is discussed including μ + p scattering spark chamber experiment, cosmic ray spark chamber experiment, and streamer chamber K_L^0 decay experiment. (W.H.K.)

33936 SWEEPNIK: A FAST SEMI-AUTOMATIC TRACK-MEASURING MACHINE. Davies, D. J. M.; Frisch, O. R.; Street, G. S. B. (Cambridge Univ., Eng.). Nucl. Instrum. Methods; 82: 54-60(1970).

A new instrument has been developed for the rapid measurement of track photographs, particularly of bubble-chamber tracks. It uses a laser beam, steered by computer-controlled mirrors, to follow the tracks on the film under the supervision of an operator. Its main advantages are: (1) high signal-noise ratio, so that thin or feeble tracks can be measured; (2) high precision due to interferometric control of the mirrors; (3) flexible operation through the use of a small on-line computer; (4) inexpensive design since only a few components require close tolerances and no complex lenses are needed. (auth)

33937 MULTIPLE SCATTERING MEASUREMENTS ON ELECTRON TRACKS IN NUCLEAR EMULSION. McNulty, P. J.; Waterman, F. M. (Clarkson Coll. of Tech., Potsdam, N. Y.). Nucl. Instrum. Methods; 82: 61-6(1970).

The reliability of multiple scattering measurements of pβc for electron energies ranging from 30 to 500 MeV is tested in nuclear emulsion by comparing them with the kinetic energies obtained through kinematics from the measured emission angles ($\leq$10°). (auth)

33938 MEASUREMENTS OF EFFICIENCY AND TIME RESOLUTION OF MULTIWIRE PROPORTIONAL COUNTERS. Koester, L. J. Jr.; Koetz, U.; Segler, S. (Univ. of Illinois, Urbana). Nucl. Instrum. Methods; 82: 67-71(1970).

This paper describes efficiency measurements of multiwire gas proportional counters in a 1 GeV/c particle beam. Results are presented as a function of the location of the particle traversal relative to the wires. Timing spectra relative to coincident scintillation counters show that 99.5% efficiency can be achieved throughout the sensitive area with a full width time resolution of 60 ns. Counter construction is outlined, and a new integrated circuit amplifier-discriminator is presented. (auth)

33939 FORMATION OF PARTICLE TRACKS BY ULTRASOUND IN A HYDROGEN BUBBLE CHAMBER. Brown, R. C. A.; Harigel, G.; Hilke, H. J. (CERN, Geneva). Nucl. Instrum. Methods; 82: 327-30(1970).

Ultrasonic expansion techniques have been tested in combination with conventional expansion in a hydrogen bubble chamber at CERN. (auth)

33940 RELATIVISTIC INCREASE OF IONIZATION AND IONIZATION EFFECTS IN NUCLEAR EMULSIONS. I. PREDICTED AND MEASURED INCREASES IN IONIZATION IN NUCLEAR EMULSIONS. Skirda, N. V. Zh. Nauch. Prikl. Fotogr. Kinematogr.; 14: 358-65(Sep-Oct 1969). (In Russian).

It is shown that the relativistic increase in grain density calculated by traditional methods is not in complete agreement with measured values and the differences can not be accounted for by experimental error. It is suggested that present ideas concerning the mechanisms of the relativistic increase in grain density may be incorrect. (C.E.S.)

33941 PHOTOGRAPHIC LAYERS OF THICKNESS 1000 TO 1200 MICRONS FOR NUCLEAR RESEARCH. Myl'tseva, V. A.; Bogomolov, K. S.; Deberdeev, M. Yu. Zh. Nauch. Prikl. Fotogr. Kinematogr.; 14: 351-8(Sep-Oct 1969). (In Russian).

Work was conducted on the process of producing layers of 1000–1200 μ thickness by increasing the concentration of solid phase photographic silver halide emulsions for decreasing shrinkage, and the effect of plasticizers on the physical-mechanical and photographic properties of the nuclear emulsion layers was studied. (tr-auth)

33942 NAP: DETECTORS AND CLOUD CHAMBERS. Yura, Tsuyoshi (Kobe Univ., Japan). Uchusen Kenkyu; 14: 297-301 (Oct 1969). (In Japanese).

The features of cloud chambers as nuclear active particle (NAP) detectors are described. The advantages of a cloud chamber are: discrimination between NAP and e–γ, between charged and neutral NAP; energy measurement; high spatial resolution; angular measurement for incident particles; and the stability of the apparatus. On the other hand, there are several disadvantages. It is not available for large area; dead time and sensitive time is long; it is very troublesome in maintenance; and it is of low economy. For a large-area NAP detector, a transition meter of sandwich type is now planned, and preliminary experiment is being performed. The difference of NAP response in a cloud chamber and a transition meter was checked, both in particle discrimination and in energy estimation. In order to construct a large-area transition meter, the flat-type proportional counter developed by the Osaka City Univ. group is now being made for test. (NSA of Japan)

Radiation Dosimeters

Refer also to abstract 33907.

33943 (CEA-R-3913) ESR STUDY OF FREE RADICALS CREATED BY IRRADIATION IN SOME ORGANIC SUBSTANCES. APPLICATION TO DOSIMETRY OF FREE RADICALS PRODUCED IN ALANINE. Descours, Solange; Assayrenc, Jacques; Bermann, Francis; Coudero, Bernard; de Choudens, Henri; Delard, Rene; Rassat, Andre; Servoz-Gavin, Pierre (Commissariat a l'En-

ergie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). May 1970. 44p. (In French). Dep. CFSTI (U. S. Sales Only).

The nature and number of radicals produced by irradiation in cysteine and glutathione were investigated. The free radicals generated in alanine were especially studied. A linear law exists in a large range of doses between the number of radicals and the absorbed dose. An application of this amino acid to the dosimetry field is made possible by the high stability of these radicals. Gamma measurements are effected between 5 and 5×10^6 rads with 1 g of alanine powder. The radical production yield is lower for neutron irradiation than for γ irradiation. By adding paraffin, it is possible to obtain a larger yield and to realize compact dosimeters easier to use than alanine powder. By addition of a higher Z constituent (Ca or Ba for example), it would be possible to improve the yield of the dosimeter for γ energies lower than 70 keV. (auth)

33944 (LA-4341) ENERGY DEPENDENCE OF ALBEDO NEUTRON DOSIMETERS PLACED ON THE HEAD. Hankins, Dale E. (Los Alamos Scientific Lab., N. Mex.). Jan 1970. Contract W-7405-eng-36. 13p. Dep. CFSTI.

A study was made of the energy dependence of an albedo neutron dosimeter system placed at various locations on the head. An albedo dosimeter placed behind the ear has an energy dependence closer to the desired rem response than a chest-mounted dosimeter. The improvement in the energy response is greatest for intermediate- and low-energy neutrons, but the response for fast-energy neutrons is still poor. The large overresponse of an albedo dosimeter caused by room-scattered neutrons and shielding materials placed between the source and the dosimeter is described. The directional effect of a head-mounted albedo dosimeter was better than a chest-mounted dosimeter.

33945 (SC-DC-70-4660) DETECTOR FOR HEALTH PHYSICS MONITORING OF PULSED NEUTRON SOURCES. Coleman, Donald J. (Sandia Labs., Albuquerque, N. Mex.). [1962]. 11p. (CONF-700609-1). Dep. CFSTI.

From 15th Annual Meeting of the Health Physics Society, Chicago, Ill.

A detector which can provide a direct reading of dose in rem (roentgen equivalent, man) from single or multiple short bursts of neutrons has been developed for health physics monitoring. The detector utilizes activation of rhodium metal by thermal and epithermal neutrons present at the center of a 10-inch spherical moderator. The spectral response of this detector should follow the RBE (relative biological effectiveness) curve within the limits accepted with related instruments using this type of moderator. Beta activity of the rhodium is detected by use of a plastic fluor in intimate contact with the metal. The system is believed to have particular value in that it is relatively simple to fabricate and calibrate and can be used with relatively common electronic equipment. Calibration procedures are described. (auth)

33946 THE APPLICATION OF A COMPUTER IN THE CZECHOSLOVAK NATIONAL FILM DOSIMETRY SERVICE. Trousil, Jaroslav; Hospes, Miroslav (Inst. for Research, Production, and Application of Radioisotopes, Prague). Jad. Energ.; 16: 158-64(May 1970).

For the calculation of gamma- and X-ray exposures, and beta doses the Elliot 803 B computer has been used in the Czechoslovak National Film Dosimetry Service. A program for calculations of calibration and correction curves, as well as separate exposure calculation programs for both gamma- and X-ray mixtures, and gamma- and beta-ray mixtures has been established. The selection blocks in programs involve identical logical steps as in the graphical method; they were, however, newly and more precisely formulated. The programs are of general validity for all dosimetric films meeting the suitability criteria previously proposed, and work well for exposure ranges of gamma-rays from 20 mR to 5 R, and for the respective exposures or doses of X- and beta-rays. (auth)

33947 SENSITIVE INTEGRATING FAST NEUTRON DOSIMETER BASED ON TSEE. Becker, K.; Crase, K. W. (Oak Ridge National Lab., Tenn.). Nucl. Instrum. Methods; 82: 297-8(1970).

A new method for integrating fast neutron dosimetry using thermally stimulated exoelectron emission from pairs of ceramic beryllium oxide discs, of which one has been covered with a non-hydrogenous material (graphite), and the other with a hydrogenous material (polyethylene), is described. The difference in the radiation effect recorded in the detectors due to the contribution of recoil protons permits to detect low fast neutron doses with a sensitivity increasing from 18 to 28% of the gamma radiation sensitivity in the 0.1 to 16 MeV neutron energy range. (auth)

33948 EFFECTS OF GRAIN SIZE AND INITIAL TRAP DENSITY ON SUPERLINEARITY OF LiF-TLD. Shiragai, A. (National Inst. of Radiological Sciences, Chiba, Japan). Health Phys.; 18: 728-9(Jun 1970).

Experimental results are presented of the difference in superlinearity of LiF-TLD due to grain size and initial trap density. IAO phosphors were compared with those of Con-Rad type N and TLD 100. IAO showed the biggest superlinearity, followed by Con-Rad type N and the smallest was TLD 100. Superlinearity was shown to increase with increase of grain size and to decrease with increase of the initial trap density in the phosphors. (UK)

33949 THERMOLUMINESCENCE PERSONNEL DOSIMETRY AT HANFORD, II. ENERGY DEPENDENCE AND APPLICATION OF TLD MATERIALS IN OPERATIONAL HEALTH PHYSICS. Endres, G. W. R.; Kathren, R. L.; Kocher, L. F. (Battelle-Northwest, Richland, Wash.). Health Phys.; 18: 665-72(Jun 1970).

Experimental photon energy response curves are presented for LiF in a variety of geometries and isotopic enrichments, $Li_2B_4O_7$-Teflon, and CaF_2:Dy blocks. A discussion of theoretical response and the effects of statistical accuracy as applied to energy dependence is also presented. The application of TLD to special dosimetry problems is shown for Pu-Al fuel element fabrication, reconstruction of X-ray exposure distribution dosimetry of soft β-emitters, and beam characteristics of flash X-ray sources. (auth) (UK)

33950 EFFECTS OF TEMPERATURE ON COBALT GLASS DOSIMETERS. Lee, P. K.; Ziemer, P. L. (Purdue Univ., Lafayette, Ind.). Health Phys.; 18: 673-80(Jun 1970).

The effects of temperature upon the radiation-induced absorbance spectra of cobalt borosilicate glass dosimeters were investigated by subjecting dosimeters to different combinations of preexposure, exposure, and post exposure temperature environments. The dosimeters were exposed to 2×10^4, 10^5, 5×10^5 and 10^6R in a ^{60}Co irradiator, and absorbance measurements were taken at 3000 Å, 3750 Å and 5000 Å over a four month study period. No significant difference in absorbance was produced by exposure temperatures within a 0°C to 100°C range, but exposure temperatures beyond 150°C resulted in decreases in absorbance levels. The radiation-induced coloration faded linearly with the logarithm of time following exposure with the fading rates being dependent upon exposure, exposure temperature, storage temperature, and the wavelength at which the absorbance spectra were measured. The coloration was completely removed by a 1 hr heat treatment at 500°C. This clarification treatment did not affect the radiation response of the dosimeters given subsequent exposures. (auth) (UK)

33951 RADIATION DOSIMETRY BY OPTICALLY-STIMULATED LUMINESCENCE OF BeO. Rhyner, C. R.; Miller, W. G. (Naval Radiological Defense Lab., San Francisco). Health Phys.; 18: 681-4(Jun 1970).

A radiation dosimeter utilizing the optically-stimulated luminescence of BeO permits repeated readings on a single sample. The response as a function of exposure is supralinear and saturates at 3×10^5 R. The lower useable limit is determined by an inherent background signal. The lower limit for BeO powder is 1 R and for BeO disks is 10 R. A phosphorescence is present following irradiation; however, the error which it produces is negligible if the samples are kept in the dark overnight. The optically stimulated luminescence decreases exponentially with repeated readouts. With the experimental conditions in this investigation, the luminescence was reduced to one-half after 39 readouts. (auth) (UK)

33952 PRINCIPAL ASPECTS OF THE INDIVIDUAL DOSIMETRY. Pierre, E. (Laboratoire Central des Industries Electriques, Fontenay-aux-Roses, France); Francois, H. J. Biol. Med. Nucl.; 5: No. 19, 16-26(Mar-Apr 1970). (In French).

Various systems are used for the individual dosimeter, the most traditional being the photographic film which has the advantage that the information it collects remains available: after development it can be kept for several months without deteriorating, and may be examined at leisure. New systems have appeared based on structural changes produced in their crystal lattice by the action of radiations. These electronic and atomic rearrangements result in luminescence phenomena of intensity proportional to the dose absorbed by the compound. A first category of dosimeters of this type includes radiophotoluminescent systems made up essentially of metallic metaphosphates. The second category covers radiothermoluminescent systems including calcium fluoride, lithium fluoride, beryllium oxide, the lithium borates, calcium sulfate, and alumina (corundum). These systems offer a wide range of possibilities, and in difficult cases different complementary types of dosimeter may be combined. (France)

33953 ALPHA-PARTICLE INCIDENCE IN SMALL TARGETS. James, A. C.; Kember, N. F. (Royal Free Hospital School of Medicine, London). Phys. Med. Biol.; 15: 39-46(Jan 1970).

A method for the direct measurement of the frequency distribution of α-particle incidence in targets of similar dimensions to cell nuclei is described. In addition to yielding the value of the mean dose in rads, these measurements enable the variation of dose in small targets to be expressed as percentages of cell nuclei receiving zero, single, or multiple incidences in a stated time interval. The relevance of this particle incidence concept of dose is discussed in relation to carcinogenesis and illustrated by actual measurements in bones containing ^{239}Pu. (auth) (UK)

33954 MANUAL ON RADIATION DOSIMETRY. Holm, Niels W.; Berry, Roger J. (eds.). New York; Marcel Dekker, Inc. (1970). 464p. $24.50.

Basic concepts in radiation dosimetry; ionization chambers; calorimetry; aqueous chemical dosimetry; radiophotoluminescent and thermoluminescent dosimetry; and films, dyes, and photographic systems are discussed. Dosimetry in radiation protection, in medical radiation therapy, in radiation research and processing, and in accelerator research and processing is considered. Also, step-by-step instructions are given for the use of 20 selected dosimetry systems. Extensive lists of references are included. (W.H.K.)

Radiometric Instruments

33955 (LFEN-NI.-50) DETERMINATION OF THE WATER CONTENT OF MATERIALS BY MEANS OF NEUTRONS. Martinho, E.; Carvalho, F. (Junta de Energia Nuclear, Sacavem (Portugal). Laboratorio de Fisica e Engenharia Nucleares). 1970. 9p. (In Portuguese). Dep. CFSTI (U. S. Sales Only).

The neutron slowing down method was used to measure the water content of Tejo sands and argil clay. The experimental conditions are reported, and the calibration curves obtained for both types of soil are given. Water content of the order of 6% can be measured in Tejo sands and approximately twice that in argil clay. (J.S.R.)

33956 CONVENIENT METHOD FOR TEMPERATURE CALIBRATION OF FURNACES. West, K. W. (Bell Telephone Labs. Inc., Murray Hill, N. J.). Nucl. Instrum. Methods; 82: 299-300(1970).

A convenient method for temperature calibration of furnaces through the use of X- or gamma-radiation is described here. A sharp increase in the intensity of an attenuated beam of radiation accompanies the melting away of a metal shield from the radiation path. The increase is used to mark the melting point of the metal composing the shield and thus determine a calibration point for the furnace. This method offers four distinct advantages: a primary standard is used; the transition of the samples is observed directly; positive indication of melting; and in many cases, no furnace modification is necessary. (auth)

33957 DESCRIPTION AND APPLICATIONS OF THE β-RE-FLECTION ANALYZER MANUFACTURED BY THE TESLA COMPANY. Toth, Endre. Atomtech. Tajek.; 12: 323-6(Sep-Oct 1969). (In Hungarian).

The MNG-201 type radiometric analyzer manufactured by the Czechoslovak Tesla-Liberec Company was used for the rapid determination of components in a mixture. The measurements are based on the determination of the change in the average atomic number of the specimen. The operation involved the determination of the back-scattered β-radiation by 2 G-M counters. The intensity of the back-scattered radiation depends on the atomic number of the elements present in the specimen. The composition changes may be derived from the mean pulse. As an example, the instrument may be used to measure the concentration changes of the high-atomic-number elements in the ashes of ore samples in mixture with the combustible components possessing low atomic numbers. The instrument consists of a measuring probe, which contains the G-M counters and a 600 μCi ^{90}Sr source, and an electronic circuit. The Si semiconductors, barrier layers and stabilized circuits operate reliably within the temperature range of +5° to +35°C and in a medium containing up to 75% of vapor. Most of the experimental error is due to the changes in the particle sizes and moisture content. The instrument may be used with great safety for process control and for the classification of coal types on the basis of their ash content. (TTT)

Miscellaneous Instruments and Components

Refer also to abstracts 33847 and 35751.

33958 (AERE-R-6407) COUPLING CAMAC TO COMPUTERS. Lewis, A. (Atomic Energy Research Establishment, Harwell (England)). May 1970. 6p. Dep. CFSTI (U. S, Sales Only). UK 1s. 9d.

The interaction between CAMAC and a computer is through a hardware coupler and an appropriate software Executive. This paper discusses some basic parameters and lays the groundwork for machine independent software. (auth) (UK)

33959 (ANL-Trans-828) NEW THERMOELECTRIC TECHNIQUES FOR TEMPERATURE MEASUREMENT. Boyer, J.; Cassien, M.; Huetz, J.; Petit, J. P. Translated for Argonne National Lab., Ill., from Paper MT 1.4 for Presentation at 4th International Heat Transfer Conference, August 29-September 5, 1970, Versailles, France. 20p. (CONF-700805-1). Dep. CFSTI.

A thermocouple indicates only the temperature of its junction. The comparison of the thermocouple's thermal level to that of the immediately adjacent medium so that this level is definable by a single value over the entire surface shared by the material and the junction is studied. The isothermal state of the junction and the thermal equilibrium of the thermocouple and the adjoining medium are discussed. The use of thermoelectric wires separately connected to the sample to reduce the response time for dynamic measurements of surface temperature is examined. Also, the possibilities of a temperature measurement in the wall of a liquid metal loop are discussed. (W.H.K.)

33960 (APDA-247) DESIGN, DEVELOPMENT, AND TESTING OF A TEMPERATURE-COMPENSATED RHOMETER FOR MONITORING IMPURITIES IN SODIUM. Huston, W. D.; Meyers, J. E.; Scott, C. C. (Atomic Power Development Associates, Inc., Detroit, Mich.). Apr 1970. Contract AT(11-1)-865. 68p. Dep. CFSTI.

The output of an automatically temperature-compensated (400-900 F) rhometer, constructed by APDA and evaluated in the APDA sodium test loop, exhibited short-term (24-hour) nonaccumulative, low-frequency oscillations of ±0.01% R (±2.5 ppM oxygen), a long-term band width of ±10 ppM oxygen), and a high-frequency noise level of ±0.005% R (±1.3 ppM oxygen). Coefficients of the instrument's response to impurities such as sodium monoxide, sodium hydroxide, water, and hydrogen gas were measured. In parallel with the development of the automatically temperature-compensated rhometer, an extensive program was conducted to determine the response coefficients of a manually temperature-compensated rhometer to such other sodium impurities as sodium hydroxide, carbon monoxide, carbon dioxide, and inert gases, as well as to gamma radiation. The major components of the rhometer exhibited good maintenance-free histories. Concepts for a commercially packaged rhometer are presented, along with projected performance for such an instrument. (auth)

33961 (LA-4357) DESIGN OF ROCKET-BORNE INSTRUMENT TO MEASURE FAR-INFRARED RADIATION IN THE NIGHT SKY. Beery, J. G.; Blair, A. G.; Edeskuty, F.; Hiebert, R. D.; Jones, D. M.; Shipley, J. P.; Williamson, K. D. (Los Alamos Scientific Lab., N. Mex.). 8 Jan 1970. Contract W-7405-eng-36. 27p. Dep. CFSTI.

A far-infrared radiation detection instrument, cooled by liquid helium and designed to be borne aloft by a Terrier-Sandhawk rocket, is described. The instrument responds to radiation in the following wavelength passbands: 6 to ~1.5 mm, 6 to ~0.6 mm, and 6 to ~0.1 mm. It has sufficient sensitivity to measure the proposed 2.7 K blackbody cosmic background radiation and significant deviations from the blackbody spectrum in the millimeter and submillimeter regions. Design features and operational characteristics of the instrument are described. Mating to the rocket, preflight preparations, parameters of the proposed flight, and postflight data handling techniques are also discussed. (auth)

33962 (LA-4389) LARGE-SIGNAL EFFECTS IN THE MULTICAVITY KLYSTRON. Talierico, Paul J. (Los Alamos Scientific Lab., N. Mex.). Feb 1970. Contract W-7405-eng-36. 14p. Dep. CFSTI.

A confined-flow, large-signal formulation of the klystron interaction equations is presented and applied to the analysis of the multicavity klystron amplifier. The effects of cavity voltage, cavity phase, drift length, and beam parameters are studied. The two- and three-cavity amplifiers are studied in detail, and several numerical examples of four-cavity klystrons are also given. A significant second-harmonic component of velocity modulation is shown to improve the dc to rf conversion efficiency. Two methods of obtaining this modulation are discussed. The large- and small-signal theories presented here have been used to design a five-cavity klystron that is 50% efficient and that has a controllable power transfer curve. Theoretical and experimental power transfer curves are presented for several 1¼ MW

klystrons; the calculated output power is between 4 and 10% greater than the experimental values. (auth)

33963 (UJV-2378-A) DIGITAL SPECTRUM STABILIZER WITH ANALOG CORRECTION REGISTER. Kosina, Z. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). Apr 1970. 8p. Dep. CFSTI (U. S. Sales Only).

A digital stabilizer for controlling the conversion gain or the zero energy intercept of a Wilkinson-type ADC is described. The stabilizer corrects the effects of all-system drifts by taking as a reference one of the natural or pulser-injected peaks of the spectrum under analysis. By using an analog-memory correction register, the number of logic elements has significantly been reduced in comparison with conventional systems of similar performance. (auth)

33964 COMPUTER–ANALYZER INTERFACING. Bahnsen, R. M.; Burke, C. A.; Lefevre, H. W. (Univ. of Oregon, Eugene). Nucl. Instrum. Methods; 82: 316(1970).

Pulse height analyzers which are designed for binary output can simplify interfacing problems, and provide additional core storage for digital computers. (auth)

33965 PEAK STABILIZED SINGLE CHANNEL ANALYZER. Grinberg, J. (Tel-Aviv Univ., Israel); Sabbah, B.; Shuster, M. Nucl. Instrum. Methods; 82: 278-84(1970).

A peak stabilized single channel analyzer has been designed. Its measured performances are in agreement with the theoretical analysis, giving a stabilizing factor greater than 600. The unit can be used as an analog spectrum stabilizer or as a normal single channel analyzer and ratemeter. With a photomultiplier included in the loop at 50 pps rate, the stabilizing factor was about 100 and the resolution widened by a factor of 1.5%. (auth)

33966 POLARIMETER BASED ON THE PHOTOELECTRIC EFFECT. Logan, B. A. (Univ. of Ottawa). Nucl. Instrum. Methods; 82: 149-56(1970).

A polarimeter based on the photoelectric effect has been constructed. The polarization sensitivity results from the photoelectrons ejected from the K-shell by linearly polarized photons being emitted predominantly in the polarization plane of the photons. A polarized photon beam obtained by the Compton scattering of a ^{60}Co beam was used to investigate the polarization sensitivity and the sensitivity was found to be high. The polarimeter is capable of good energy resolution and, although the detection efficiency is low, the high polarization sensitivity may allow a relatively low statistical accuracy to be tolerated. (auth)

33967 MAGNETIC FIELD PROBE FOR PRECISE MAGNETIC FIELD MEASUREMENTS. Kaltenbach, V.; Kuhlmann, W. R. (Kernforschungsanlage, Juelich, Germany). Nucl. Instrum. Methods; 82: 245-8(1970). (In German).

A method for measuring magnetic fields is described, which uses a rotating and a fixed coil. The fixed coil gives an ac-signal proportional to the magnetic field. Some basic theoretical results are discussed and a simple experimental setup is described. This method seems to be adequate for high precision measurements. (auth)

33968 SHORTING MODIFICATION FOR Co-Ax CONNECTORS. Biggerstaff, J. A.; Loftus, J. M. (Oak Ridge National Lab., Tenn.). Nucl. Instrum. Methods; 82: 294(1970).

A method to modify the GR-874 connector to protect cables and measuring equipment is briefly described. A slot is milled in the larger diameter part of the outer conductor and a grasshopper spring is soldered to it which shorts the connector when it is not mated. (W.H.K.)

33969 RESEARCH OF THE ELECTRONICS GROUP. Coche, Andre. Acta Client.; 2: 89-96(Apr-Sep 1969). (In Spanish).

The main lines of research by the Electronics Group from the Center for Nuclear Research of Strasbourg (France) are outlined. These include high frequency performance of transistors: low-noise, broadband amplification techniques; and short time period measurements. Also, research work undertaken in parametric amplification techniques is reported. (auth)

33970 APPARATUS FOR ADMINISTRATION OF RADIOACTIVE AEROSOLS FOR SCINTIGRAPHY OF THE LUNGS. Vigne, J. P.; Martinet, H.; Laval, P. (Hospital de Sainte-Marguerite, Marseille). pp 161 of Radioactive Isotopes in the Localization of Tumours. /McCready, V. R. (ed.). London; William Heinemann Medical Books Ltd. (1969).

From Symposium on Radioactive Isotopes in the Localization of Tumours, London, England. See CONF-670948.

A technique based on the use of a commercial nebulizer which atomizes 1/10 ml per minute is described. Electromagnetic valves are used to control the system and there is an extensive filter system. Scintigraphs obtained using 200–300 μCi gold-198 in the lungs required 2 to 3 mCi gold-198 to be nebulized. Typically, 30 mCi gold-198 were collected daily in the filters when the equipment was in regular clinical use. (UK)

33971 PARALLEL TUNNEL DIODE COINCIDENCE CIRCUIT. Hirayama, Hiroshi; Lim, In Chil (Waseda Univ., Tokyo). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; 17: No. 2, 7-17 (Apr 1970).

A fast coincidence circuit which operates reliably over a wide range of input-pulse amplitudes is described. The ratio of the current which is applied to the main tunnel diode when the circuit receives a noncoincident input-pulse to that when both inputs of the circuit receive coincident input-pulses, is always one to four, independent of input-pulse amplitudes. The value of the current to be applied to the main tunnel diode by input pulses is decided by the bias current of the circuit. The resolving time of the circuit is measured as 2 ns in the typical operation of the circuit and as 400 ps by adjusting input-pulse amplitudes and the bias current. (auth)

33972 SPECIAL PURPOSE TIMER FOR USE IN NUCLEAR COUNTING. Samdani, M. G. (Atomic Energy Centre, Dacca, Pakistan). Nucl. Sci. Appl., Ser. A; 5: 53-63(Apr 1969).

An electronic timer has been developed in the Electronics Laboratory of AEC, Dacca which can be used for controlling counting time in nuclear research. The unit is able to provide prior warning to experimenters and also shows elapsed time of the experiments. This timer can be set for any time from 5 minutes to 30 minutes at a regular interval of 5 minutes. Proper lighted signals show the position of the counting, e.g., Run, Warning and Over. These are done automatically through the use of a number of electronic logic circuits. Besides its use in nuclear experiments, it may find immediate use in timing in the television studios in this country. The unit has been modeled as APT-30 and will shortly be applied for patent right. (auth)

33973 NEW DESIGN TECHNIQUES OF VARIABLE PRESCALING COUNTERS FOR SPACEBORNE EXPERIMENTS. Cantarano, S.; Pallottino, G. V. (Univ., Rome). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; 17: No. 2, 34-9(Apr 1970).

The design techniques of prescaling counters for the automatic compression of particle measurement data on board spacecrafts are reviewed and new criteria are proposed, which are illustrated by examples. The standard technique of realizing logarithmic counters is criticized and alternative procedures are proposed that take into account both the effect of the statistical error when counting events from random sources and the efficient use of all the a priori information available about the expected counts. The resulting structure consists of a prescaling counter, where the number of stages of the prescaler that are inserted does not coincide anymore with the content of the exponent section, but is an arbitrary function of that number. (auth)

33974 SIMPLE METHOD FOR MAINTAINING THE RESONANCE CONDITION IN A SPIN ECHO NUCLEAR MAGNETIC RESONANCE SPECTROMETER. Packer, K. J.; Strike, A. J. (Univ. of East Anglia, Norwich, Eng.). J. Magn. Resonance; 2: 79-87(Jan 1970).

A device is described which will correct for drifts in the resonance condition of a spin echo spectrometer. It operates by measuring the voltage at the output of the spectrometer's phase sensitive detector a definite time after the nuclei in the sample under study have received a 90° rf pulse. The phase detector is used with an initial phase angle difference of 90°. The measured voltage is used to correct the magnetic field towards its resonance value. The particular unit described in detail accomplishes both field-frequency correction and nuclear resonance signal measurement with the same phase detector. (auth) (UK)

33975 CONFERENCE RECORD. 1968 IEEE Region Six Conference, Held May 20, 21, and 22, 1968 at Portland, Oregon. IEEE Catalog No. 68C19-Reg-6. Portland, Oreg.; Institute of Electrical and Electronics Engineers (1968). 206p. $5.00. (CONF-680502).

Forty-nine papers are presented on various aspects of electronics serving mankind in the areas of oceanography, energy sources, transportation, computers, bioscience, aerospace, communications, education, lasers, and simulation. Separate abstracts are prepared for three of the papers. (C.E.S.)

For abstracts of individual papers see: 33906, 35478, and 35946.

33976 LOW TEMPERATURE MICROBALANCE WITH TWO QUARTZ CRYSTALS FOR MEASURING MULTICHANNEL ATOMIC BEAM INTENSITIES. Abjean, R.; Pochat, A.; Johannin-Gilles, A. (Faculte des Sciences, Brest, France). Vacuum; 20: 193-6(May 1970).

A quartz crystal microbalance operating at temperatures to –130°C has been used for measuring multichannel atomic beams of mercury, cadmium and zinc, whose intensities were about 10^{15} at./cm^2 sec. A novel feature of the experimental arrangement is that the measuring crystal and the standard crystal are both at low temperature and maintained under identical conditions to minimize the effects of temperature variations and backstreaming. (auth) (UK)

Radiation Effects on Instruments and Instrument Components

Refer also to abstracts 35243 and 35290.

33977 (BNWL–1325–2) REACTOR ENGINEERING DEVELOPMENT. REACTOR ENVIRONMENTAL EFFECTS ON SIGNAL CABLES. Quarterly Report, January–March 1970. Stringer, J. L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Apr 1970. Contract AT(45-1)-1830. 35p. Dep. CFSTI.

The experimental investigations of this program are to (a) provide a better understanding of radiation induced currents so that maximum limits can be determined for the magnitude of the current induced in a specific radiation environment; (b) measure and study the noise generated in the metal oxide insulator used in signal cables as a function of radiation, temperature and applied voltage both as an aid in understanding the generation mechanism and in determining the noise limit for instrumentation applications, and (c) provide bulk insulator conductivity data as a function of radiation and temperature for other powder insulation materials presently available in signal cables for engineering design (i.e., SiO_2, Al_2O_3, ThO_2, BeO, ZrO_2 and HfO_2). Research progress is reported. (auth)

33978 (CEA-CONF–1508) EFFECT OF 1-MeV ELECTRON IRRADIATION ON MOS STRUCTURES. MECHANISM OF FORMATION AND THERMAL NEUTRALIZATION OF THE SPACE CHARGE. Saminadayar, K.; Bernard, J. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). 1969. 17p. (In French). (CONF-690640–1). Dep. CFSTI (U. S. Sales Only).

From Conference on Properties and Use of MOS Structures, Grenoble, France.

Transistors and capacitors of very simple geometry, formed with a layer of wet thermal silica and a layer of aluminum, were irradiated by 1-MeV electrons. The threshold potential of the MOS transistors and the capacity and conductance of the MOS capacitors were measured. The phenomena of formation of the space charge zone with both continuous and pulse polarizations are presented. Mechanism of the space charge annealing during the thermal annealing process is explained. (France)

33979 DEGRADATION MECHANISM OF MOS STRUCTURES AND TRANSISTORS UNDER IONISING RADIATION. Esteve, D.; Buxo, J. (CNRS, Toulouse). Electron. Lett.; 6: 198–200 (2 Apr 1970).

The physical nature of the emission-current mechanism involved at each heterojunction when MOS components are irradiated is discussed. The validity of this mechanism is tested with an overall experiment, and its practical consequences analyzed on the form of the $\Delta V_G(V_G)$ degradation curve. (auth) (UK)

33980 LIFETIME IN NEUTRON IRRADIATED SILICON: APPLICATION TO DEVICES. Kawamoto, H.; Oldham, W. G. (Univ. of California, Berkeley). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; 17: No. 2, 26–33(Apr 1970).

Detailed measurements on special gated Si pn diodes yield the damage parameters associated with the three basic current components in p–n junctions. Recombination in the neutral bulk, recombination and generation in the space-charge region, and recombination and generation at the surface are characterized over a wide range of neutron doses and injection levels. For recombination in the neutral bulk, the lifetime damage constant is about 3×10^5 n-sec/cm^2 at high injection levels and varies with dose between 10^3 and 10^4 n-sec/cm^2 for low injection levels. The damage constant for the space-charge region recombination lifetime is about 5×10^5 n-sec/cm^2 for forward biases in the range of 0.1 to 0.3 V and the damage constant for the generation lifetime in the space-charge region is 5×10^7 n-sec/cm^2 both nearly independent of dose. The surface generation and recombination velocities are process dependent and are not a linear function of the dose. The surface generation velocity increases from about 10 cm/sec at 2×10^{11} n/cm^2 to saturate at about 100 cm/sec at 10^{14} n/cm^2 in the diodes studied. Using these data, the grounded emitter current gain (h_{FE}) for a Si pnp transistor (2N4872) is predicted as a function of dose and current density. Both the dose and the current density dependence of h_{FE}, as predicted by V- I characteristics and deduced lifetimes, are in reasonable agreement with the published specifications. It is found in this transistor that emitter space-charge recombination is the dominant mechanism for h_{FE} degradation for moderate current densities (1 to 100 A/cm^2). (auth)

33981 RELIABILITY OF COMPONENTS AND ELECTRONIC SYSTEMS IN A SPACE ENVIRONMENT. Giralt, M. G. (LAAS–CNRS, Toulouse). pp 207-28 of Calcul des Doses de Radiations dans l'Espace. Elbaz, C. (ed.). Toulouse; Comptes Rendus de Journees Europeennes (1968). (In French).

From Calculation of Radiation Doses in Space Conference, Toulouse, France. See CONF-680219.

The problem of reliability is considered from the point of view of evolution of parameters that are recognized as significant of the component or of the system. The notion of failure is in these conditions related to certain characteristic limiting values of the system and to the mission which it is destined to fulfill. The following are considered: conditions of the functioning of the system (internal stresses); conditions imposed by the surroundings (environmental stresses); influence of these stresses on physical parameters recognized as relevant; influence of physical parameters on the electric parameters of the system; and influence of the variation of electric parameters on the quantitative and qualitative behavior of the system. If the essential problem lies in the possibility of arriving at a deterministic estimation of the future behavior of the system, it is, in fact necessary on one hand to take into account the imperfections of the general mathematical model of the component, whether this has been obtained by an analytic method or by that of identification arising from experimental results, and on the other hand, take into account the imperfect knowledge of the stresses. The evolution of the system can therefore be described by means of the three following types of behavior: random catastrophic failure behavior; random continuous evolution behavior; and deterministic behavior. The determination of the optimal structure of a system can be dealt with from this point of view by taking into account the possible compensation or sensitivity coefficients minimization by feedback networks. (auth)

33982 BEHAVIOR OF THE SOLAR CELL Al.2F.H_2 UNDER IRRADIATION. Lesbre, M. D. (CESR, Toulouse). pp 287-300 of Calcul des Doses de Radiations dans l'Espace. Elbaz, C. (ed.). Toulouse; Comptes Rendus de Journees Europeennes (1968). (In French).

From Calculation of Radiation Doses in Space Conference, Toulouse, France. See CONF-680219.

A systematic survey of the radiation behavior in view of defining the most-resistant structure under irradiation, was carried out on silicon n/p solar cells. Six different types of cells were subjected to irradiation by electrons at 4 MeV: two types obtained by the "floating-zone method" are much less degraded than standard cells. The synthesis of these two types led to the Al/ZFH_2 cell, doped with aluminum and made from monocrystals grown under a floating zone with a hydrogen atmosphere. Their behavior under 1-MeV electron irradiation shows that this new cell is approximately six times more resistant than standard cells. (auth)

33983 RADIATION EFFECTS ON THIN-FILM SOLAR CELLS. Lebrun, J. (RTC, Suresnes, France). pp 301-6 of Calcul des Doses de Radiations dans l'Espace. Elbaz, C. (ed.). Toulouse; Comptes Rendus de Journees Europeennes (1968). (In French).

From Calculation of Radiation Doses in Space Conference, Toulouse, France. See CONF-680219.

After a brief survey on structures of CdS, AsGa and CdTe thin films, some results concerning irradiation of these cells to electrons of 425 keV to 1.5 MeV energy, to 100 keV to 2.4 MeV protons and to γ rays are presented. Doses vary depending on the cases, from 10^{10} to 10^{18}/cm^2. (auth)

33984 DEVIATIONS OF MOS TRANSISTORS UNDER RADIATION. Glotin, P.; Bernard, J. pp 307-28 of Calcul des Doses de Radiations dans l'Espace. Elbaz, C. (ed.). Toulouse; Comptes Rendus de Journees Europeennes (1968). (In French).

From Calculation of Radiation Doses in Space Conference, Toulouse, France. See CONF-680219.

The fabrication and electrical characteristics (voltage characteristics, capacity curves, and conductivity curves) of MOS transistors are reviewed. Various models for explaining radiation effects on MOS transistors are discussed. Also, results obtained during irradiation tests of the D2 satellite telemetry coder are presented and discussed. (TSS) (auth)

33985 INFLUENCE OF OPERATING CONDITIONS ON THE BEHAVIOR OF TRANSISTORS UNDER IONIZING RADIATION. Pelous, M. G. (CNET, Lannion, France). pp 329-40 of Calcul des Doses de Radiations dans l'Espace. Elbaz, C. (ed.). Toulouse; Comptes Rendus de Journees Europeennes (1968). (In French).

From Calculation of Radiation Doses in Space Conference, Toulouse, France. See CONF-680219.

Many experiments have studied surface phenomena under low radiation dose as in space in degradation of planar transistor current gain. A review of assumptions about the mechanisms of these phenomena are made, laying emphasis on the consequence of irradiation conditions, including operating voltage and temperature. In conclusion, the required data for selection or evaluation of the variation of transistor-gain under radiation are given. (auth)

33986 PROBLEM OF EQUIVALENCE FOR DEGRADATIONS IN SINGLE-CRYSTAL SOLAR CELLS. Bernard, J. (CERTS, Toulouse). pp 369-82 of Calcul des Doses de Radiations dans l'Espace. Elbaz, C. (ed.). Toulouse; Comptes Rendus de Journees Europeennes (1968). (In French).

From Calculation of Radiation Doses in Space Conference, Toulouse, France. See CONF-680219.

When single silicon crystal solar cells are degraded by energetic electrons, the length of L diffusion varies with the dose ϕ following the formula: $1/L_2 - 1/L_1^2 = K(E) \cdot \phi \cdot (E)$. The coefficient K (E) was determined experimentally under ambient temperature as a function of the energy. Starting from a certain hypothesis, this coefficient was computed as a function of energy, temperature, and resistivity. Values obtained experimentally are compared with the calculated values to show that it would be both possible and interesting to carry out in one operation, experiences and computations on the same samples of silicon. (auth)

33987 SIMULATION OF THE EFFECTS OF PULSED IONIZING RADIATIONS BY LASER. Bielle, J. (Univ., Toulouse). pp 383-91 of Calcul des Doses de Radiations dans l'Espace. Elbaz, C. (ed.). Toulouse; Comptes Rendus de Journees Europeennes (1968). (In French).

From Calculation of Radiation Doses in Space Conference, Toulouse, France. See CONF-680219.

The possibility of utilizing lasers for simulation of pulsed ionizing radiation effects (nuclear "bursts") on semiconductor devices is analyzed. The advantages and disadvantages of this means of simulation are studied and compared with other means utilized (linear accelerators and x-ray generators). The effects of the pulses delivered by a glass laser doped with neodymium ($\lambda = 1.06\ \mu$) on silicon was studied, in particular, and results are presented. (tr-auth)

LIFE SCIENCES

Biochemistry, Physiology, and Molecular Biology

Basic Processes

Refer also to abstracts 33642, 33643, 34230, 34338, 34383, 34428, 34483, 34495, 34496, 34498, 34499, 34502, 34503, 34510–34512, and 34526.

33988 (BNWL–1050(Pt.1), pp 6.21-4) SUBCELLULAR LOCALIZATION AND IDENTIFICATION OF ALPHA EMITTERS BY ELECTRON MICROSCOPIC AUTORADIOGRAPHY. Adee, R. R.; Sanders, C. L.; Berlin, J. D. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

From Pacific Northwest Laboratory annual report for 1968 to the USAEC Division of Biology and Medicine. Vol. I. Life sciences. Pt. 1. Biological sciences.

A method of electron microscopic autoradiography is described whereby the localization and identification of particulate emitters such as ^{239}Pu, within biological systems at the subcellular level can be confidently demonstrated. (auth)

33989 (UCRL–19420, pp 1-8) VISUALIZATION OF RADIOACTIVITY IN THE DOG FOLLOWING ADMINISTRATION OF VARIOUS ^{11}C–CARBOXYLATES. Winchell, H. Saul; Winstead, Meldrum B. (California Univ., Berkeley. Lawrence Radiation Lab.).

Low-radiation-dose high-resolution tomographic positron scintiphotography, and potential for isologous labeling of a large variety of organic compounds attendant on its use, make ^{11}C potentially an extremely important radioisotope in nuclear medicine. Results of studies in dogs using ^{11}C-carboxylates demonstrated rapid renal concentration and excretion of benzoate, p-chlorobenzoate, and 2-thiophenecarboxylate, suggesting their usefulness in morphological as well as functional studies of this organ. Hepatic as well as renal concentration of phenylacetate, 3,4-dimethoxybenzoate, o-hydroxybenzoate (salicylate), and cyclohexanecarboxylate suggests their use in morphological and functional studies of both these organs. In addition to accumulation and excretion of 1-naphthoate and pentanoate in the liver and kidneys, these compounds were localized in the gallbladder, suggesting their use in morphological and functional studies of this organ. The apparent exclusion of all these compounds from the brain and their lack of concentration in salivary glands and nasal sinuses suggest their possible usefulness in visualization of brain lesions. The diffuse abdominal distribution of butyrate and octanoate suggests accumulation in mesenteric and omental fat, and if such is the case, further studies with these materials might be useful in visualizing the kinetics of fatty-acid deposition. (auth)

33990 (UCRL–19420, pp 40-5) EFFECTS OF LARGE DOSES OF UNLABELED L-METHIONINE ON $^{14}CO_2$ PRODUCTION IN RATS GIVEN L-HISTIDINE (IMIDAZOLE-2-^{14}C), L-SERINE-3-^{14}C, FORMIMINO-^{14}C L-GLUTAMIC ACID, AND ^{14}C-FORMATE. Ngo, Tran Manh (California Univ., Berkeley. Lawrence Radiation Lab.).

Following administration of L-histidine (imidazole-2-^{14}C), L-serine-3-^{14}C, and formimino-^{14}C L-glutamic acid to normal rats that were given large doses of L-methionine, the initial rate and amount of $^{14}CO_2$ excreted in the breath were significantly decreased, whereas following administration of ^{14}C-formate, $^{14}CO_2$ appearance was unchanged in methionine-treated rats. These results indicate the presence of in vivo competition for physical transport of these amino acids across cell membranes. (auth)

33991 PROGRESS AND PROBLEMS ON IN VIVO ACTIVATION ANALYSIS. Proceedings of Conference, East Kilbride, Glosgow, 10–11 April 1969. Boddy, K. (ed.). Glasgow; Scottish Research Reactor Centre (1969). 74p. (SRRC–34/69; CONF-690435).

Short summaries are given of the following papers, together with full discussions: "The establishment of suitable neutron fluxes for whole body irradiation of patients" by J. H. Fremlin and I. Holloway; "In vivo neutron activation analysis of total body Ca" by W. B. Nelp et al.; "Whole-body neutron activation analysis of Ca" by S. H. Colin et al; "Some clinical results of the whole-body irradiation of patients with fast neutrons" by N. J. Chamberlain and D. K. Peters; "Partial body and total body determinations of P by in vivo activation analysis" by H. E. Palmer et al; "Use and limitation of a general purpose research reactor in partial body in vivo activation analysis" by K. Boddy and W. D. Alexander; "Neutron dosimetry in relation to in vivo activation analysis" by J. A. Dennis; "Interfering reactions and selection of neutron energies" by C. K. Battye; "Monitoring geometry and sensitivity" by H. E. Palmer; "Uniformity of activation" by D. Newton; and "Accuracy and precision" by J. H. Fremlin. (UK)

33992 RADIOIMMUNOASSAY OF THE LUTEINIZING HORMONE (LH) IN BLOOD SERUM OF COWS DURING THE FIRST TWO MONTHS OF PREGNANCY. Schams, D. (Technische Hochschule, Munich). Deut. Tieraerztl. Wochenschr.; 76: 567-600(Nov 1969). (In German).

From two cows blood samples were taken on an average three times daily during a period from estrous until approximately 2 months after insemination. Luteinizing hormone was determined in the serum with radioimmunoassay. There was no elevation of the LH-level observed during the shift from the corpus luteum periodicum to the corpus luteum graviditatis. Surprisingly LH-peaks could be found on day 52 (cow A) and day 61 (cow B) of pregnancy. The peaks were according to their short appearance characteristic for hypophyseal origin. (auth)

33993 CHARACTERIZATION OF ANTISERA FOR HUMAN FOLLICLE-STIMULATING HORMONE RADIOIMMUNOASSAY. Cargille, Charles M.; Rayford, Phillip L. (National Cancer Inst., Bethesda, Md.). J. Lab. Clin. Med.; 75: 1030-40(Jun 1970).

Recent reports describing radioimmunoassays for measuring plasma gonadotropins show marked differences in the design and extent of studies intended to prove the validity of measurements. Methods found useful in characterizing a new antiserum and establishing the reliability of an assay for follicle-stimulating hormone (FSH) are reported. These studies characterize the assay with respect to: sensitivity, specificity, precision, accuracy, similarity of dose-response relationships of standard and unknown, and agreement of biological and immunological results in physiological studies. (auth)

33994 PROTEINS RELEASED FROM CHICK EMBRYO FIBROBLASTS IN CULTURE. I. PARTIAL CHARACTERIZATION OF THE PROTEINS. Halpern, M.; Rubin, H. (Univ. of California, Berkeley). Exp. Cell Res.; 60: 86-95(Apr 1970).

A study was made of the proteins released from embryonic chick fibroblasts in culture. Incorporation of ^{14}C amino acid into a prealbumin as well as other proteins sharing antigenic determinants with components of chicken serum was demonstrated by means of radioimmunoelectrophoresis and radioimmunodiffusion. The release of labeled prealbumin by cultured cells prelabeled in the embryo suggested that fibroblasts synthesize this component in the embryo as well as in culture. Evidence was obtained indicating that, contrary to earlier reports, cultured fibroblasts do not produce albumin or γM globulin. (auth)

33995 DIFFUSION OF CARBON COMPOUNDS AWAY FROM WHEAT ROOTS. Rovira, A. D. (Commonwealth Scientific and Industrial Research Organization, Glen Osmond, Australia). Aust. J. Biol. Sci.; 22: 1287-90(Oct 1969).

$^{14}CO_2$ was used to study roots or parts of roots. The sandwich techniques of Bowen, Nature 218: 686 and others was used on wheat and representative scans are given. A combination of $^{14}CO_2$ pulse labeling, autoradiography, and scanning of the paper strip in contact with roots revealed that the recently photosynthesized carbon of root tips makes a greater contribution to exudation than older parts. Only small amounts of diffusible exudate were detected. The results indicated that roottips growing through the soil will release much non-diffusible material that may play an important role in soil aggregation, nutrient availability and uptake, and nutrition of microorganisms. (Australia)

33996 EFFECTIVE TISSUE THICKNESSES FOR EXTERNAL COUNTING OF LOW ENERGY EMITTERS IN LUNG. Rundo, J.; Rudran, K.; Taylor, B. T. (Atomic Energy Research Establishment, Harwell, Eng.). Health Phys.; 17: 155-7(Jul 1969).

Reference is made to the results of a calibration experiment in vivo using an inhaled aerosol of 17-day ^{103}Pd, which emits rhodium K_α X-rays at 20.2 keV, the same energy as the uranium L_γ line emitted by plutonium-239. Chest contents of ^{103}Pd were determined by measurement of the content of the ^{51}Cr γ-ray "label" incorporated with the ^{103}Pd in the polystyrene microspheres employed. The experimental data are now analyzed to yield values for the effective thickness of soft tissue. Although

this is a fictitious quantity it may be useful, as it takes account of self-absorption in the lung tissue, and it can be used to calculate counter efficiency from measurements with a point source. (auth) (UK)

33997 A METHOD FOR SIMULTANEOUS ELECTROLYTE INVESTIGATIONS IN MAN USING ^{77}Br, ^{43}K, AND ^{24}Na. Skrabal, F.; Arnot, R. N.; Helus, F.; Glass, H. I.; Joplin, G. F. (Hammersmith Hospital, London). Int. J. Appl. Radiat. Isotop.; 21: 183-91 (Apr 1970).

The different gamma energies of ^{24}Na, ^{43}K and ^{77}Br allow analysis of mixtures of the three isotopes without any previous separation procedure, by gamma counting under three different conditions. A computer program is used to perform the calculations. In vitro experiments show that mixtures of the three isotopes can be analyzed with an error of less than 2 per cent. The method is applied for simultaneous estimation of extracellular fluid volume, sodium space, exchangeable sodium and exchangeable potassium. The results are compared with a resin separation method and the findings in 10 subjects without electrolyte disorders are presented. (auth) (UK)

33998 NEW TECHNIQUE TO DENATURE RED CELLS FOR SPLEEN SCANNING. Sharma, S. M.; Patel, M. C.; Ramanathan, P.; Ganatra, R. D.; Blau, M. (Tata Memorial Hospital, Bombay). J. Nucl. Med.; 11: 228-32(Jun 1970).

The use of concentrated acid citrate dextrose (ACD) and stable sodium chromate to denature the ^{51}Cr-tagged autologous red cells for spleen scintiscanning is described. Organ distribution data in rats and dogs four and 24 hr after i.v. injection of labeled erythrocytes with and without modification is presented. Studies show that combination of concentrated ACD and stable chromate yields maximum sequestration of labeled cells in the spleen with very low concentrations in liver, kidneys, and circulating blood. The technique was successfully used in 20 patients. Representative spleen scans of two patients are shown. The advantages of combined ACD and stable chromate denaturation over the heat-treatment technique are simplicity and quicker denaturation. (C.H.)

33999 ^{99m}Tc DTPA: A NEW RADIOPHARMACEUTICAL FOR BRAIN AND KIDNEY SCANNING. Hauser, W.; Atkins, H. L.; Nelson, K. G.; Richards, P. (Brookhaven National Lab., Upton, N. Y.). Radiology; 94: 679-84(Mar 1970).

Technetium-99m was combined with the chelating agent DTPA in order to obtain a scanning agent with the physical properties of the radionuclide technetium-99m and the desirable biological properties of chelating agents. The method for the preparation of the chelate is described. No toxic effects are expected. About 90% of the compound is eliminated by the kidneys in twenty-four hours. The absorbed radiation dose is 0.042 rad/mCi by the kidneys and 0.555 rad/mCi by the bladder. In clinical studies the chelate is useful for scanning of brain and kidneys and for vascular dynamic studies. (auth)

34000 A DOUBLE ISOTOPE METHOD TO MEASURE VITAMIN B_{12} ABSORPTION. Campbell, C. B.)queensland Univ., Brisbane, Australia); Carswell, P. W. Australas. Ann. Med.; 19: 42-6(Feb 1970).

A double isotope method, using ^{51}Cr chromic chloride as a non-absorbable marker, was used to study absorption of vitamin B_{12}. Results were compared with those obtained by the Schilling test, and, in some patients, the total fecal excretion method. The test proved reliable with certain advantages over other methods of assessing vitamin B_{12} absorption. It measures absorption directly, does not require quantitative collection of excreta, is independent of renal function, and results are available within 48 hours. (Australia)

34001 LUTEINIZING HORMONE SECRETION DURING THE OESTROUS CYCLE OF THE EWE AS DETERMINED BY RADIOIMMUNOASSAY. Wheatley, L. S.; Radford, H. M. (Ian Clunies Ross Animal Research Lab., Prospect, New South Wales). J. Reprod. Fert.; 19: 211-14(1969).

Preliminary results are presented on the use of a radio immunoassay method involving the use of LH ^{125}I prepared by the method of Greenwood, Hunter and Glover (1963) for the determination of LH in the blood of ewes throughout the oestrous cycle. Particular attention was paid to the period around oestrus. The results provide accurate information on the time relationships between the limits of the oestrous period and the oestrous LH peak. The rise in LH during oestrus occurred apparently several hours later than the time at which pharmacological agents will uniformly block ovulation in the ewe. It seems likely, then that the neural stimulus for LH release and LH release itself are not synchronous in this species. (Excerpta Med.)

34002 IN VITRO INCORPORATION OF TRITIUM INTO NATIVE DNA. Doppler-Bernardi, Francoise; Felsenfeld, Gary (National Insts. of Health, Bethesda, Md.). Biopolymers; 8: 733-41(1969).

An exchange method is described for producing tritium-labeled native DNA in vitro with minimal physical damage to the DNA. Tritium-labeled calf thymus DNA prepared in this way has a specific activity of about 100 μCi/mmole of nucleotide (i.e., about 2×10^8 dpm/mmole). Sedimentation velocity at neutral and alkaline pH indicate that the product has an average of two single strand breaks per duplex molecule of molecular weight 6×10^6 daltons. The optical and thermal denaturation properties of the product are those of native DNA. The method should be particularly useful for labeling DNA from organisms that cannot be labeled conveniently in vivo. (auth)

34003 IMMUNOASSAY OF GONADOTROPHINS. Transactions of the First Karolinska Symposium on Research Methods in Reproductive Endocrinology, Stockholm, September 23-25, 1969. Diczfalusy, E. (ed.). Acta Endocrinol., Suppl.; 63: No. 142, 1-382(1969). (CONF-690946).

Separate abstracts were prepared for eleven papers presented at the conference. An additional eight papers were presented on various aspects of immunoassay of gonadotropins. (H.L.W.)

For abstracts of individual papers see: 34004-34014.

34004 CHEMISTRY OF GONADOTROPHINS IN RELATION TO THEIR ANTIGENIC PROPERTIES. Butt, W. R. (Birmingham and Midland Hospital for Women, Birmingham, Eng.). Acta Endocrinol., Suppl.; 63: No. 142, 13-30(1969).

From 1st Symposium on Immunoassay of Gonadotrophins, Stockholm, Sweden. See CONF-690946.

Several chemical differences between FSH, LH , and HCG have been reported; thus LH and HCG are richer in proline than FSH and FSH and HCG contain more N-acetyl neuraminic acid than LH. Sub-units of LH are formed by treatment with urea, guanidine or acid. HCG also may contain two sub-units. The sub-units from LH are biologically inert but retain their immunological activity; biological activity is restored when the sub-units are incubated together. There is much evidence from chemical and enzymic reactions that antigenic groups are distinct from those parts of the molecule essential for biological activity. N-acetyl neuraminic acid and probably other carbohydrates in FSH and HCG are not involved in immunological activity but are necessary for biological activity. Histidine, methionine and possibly cysteine appear to be essential for biological but not immunological activity of FSH, while tryptophan and possibly tyrosine are not essential for either. A few highly specific antisera to gonadotrophins have been prepared in rabbits and guinea pigs to crude antigens; there is no evidence that purified antigens are more likely to produce specific antisera. Differences in the immunological reactivities of urinary compared with pituitary gonadotrophins have been observed both by radioimmunoassay and by the complement fixation technique. The latter may be particularly useful for detecting structural differences in the hormones. (auth)

34005 INFLUENCE OF IMMUNIZATION PROCEDURES ON THE TITER, AFFINITY, AND SPECIFICITY OF ANTISERA TO GLYCOPOLYPEPTIDES. Odell, William D.; Abraham, Guy; Raud, H. Randar; Swerdloff, Ronald S.; Fisher, Delbert A. (Harbor General Hospital, Torrance, Calif. Univ. of California, Los Angeles). Acta Endocrinol., Suppl.; 63: No. 142, 54-76(1969).

From 1st Symposium on Immunoassay of Gonadotrophins, Stockholm, Sweden. See CONF-690946.

HLH, HTSH, HCG, and HFSH are glycopolypeptides with similar molecular weights and immunological properties. Production of antisera useful in specific radioimmunoassays has been difficult. Immunization of rabbits with each of these hormones homogenized in complete Freund's adjuvant is routinely followed by antiserum production. Titers rise progressively with repeated immunizations for ten weeks or more and then the rate of increase falls. Rabbits producing higher titers of antiserum after two immunizations generally continue to produce higher titers during additional immunizations, thus selection of animals early during immunization is possible. Affinity of the antisera against all four hormones generally also increases during the course of immunization. Several ways of estimating affinity of antisera are presented. Antisera capable of use to produce specific radioimmunoassays need not necessarily contain only antibodies against the hormone to be measured. Thus antisera against LH might be present in an antiserum used to quantify HFSH, if the anti HLH did not bind HFSH in either radioactive or nonradioactive form. Specificities of antisera vary a great deal and consideration of the nature of cross reacting substances would be effective in producing specificity. Thus when HLH reacted completely and equally with HFSH

in an HFSH assay, absorption would completely neutralize all anti HFSH antibodies. If HLH and HFSH had dose response curves with quite different slopes (and hence different affinities for the anti HFSH), absorption is possible. When two or more populations of antibodies against HFSH are demonstrable by the presence of biphasic dose response curves in the assay, and if one population is specific, absorption of the nonspecific population may be possible. (H.L.W.)

34006 ASSESSMENT OF RADIOIODINATED HORMONE PREPARATIONS. Hunter, W. M. (Medical Research Council, Edinburgh). Acta Endocrinol., Suppl.; 63: No. 142, 134-44 (1969).

From 1st Symposium on Immunoassay of Gonadotrophins, Stockholm, Sweden. See CONF-690946.

The preparation of radioiodinated human LH and human FSH with specific activities of 50 to 150 μc/μg for use in specific radioimmunoassay systems is described. Methods for minimizing iodination danger, for removing severely damaged fractions after iodination and for assessing the immunological reactivity of the final products are detailed. The obligation upon immunoassayists to demonstrate that their labeled preparations do indeed represent the hormones under consideration is discussed and criteria that may contribute evidence on this question are put forward. (auth)

34007 LABELLING OF ANTIGENS BY VARIOUS ISOTOPES. Eshkol, Aliza (Tel-Hashomer Government Hospital, Israel). Acta Endocrinol., Suppl.; 63: No. 142, 145-62(1969).

From 1st Symposium on Immunoassay of Gonadotrophins, Stockholm, Sweden. See CONF-690946.

Isotopically labeled protein or polypeptide hormones are chemically and/or structurally different from the native material. This may be a major handicap when biological studies or radioimmunoassays are performed. Labeling procedures with ^{131}I, ^{125}I or by introduction of ^{3}H (exchange, acetylation, alanylation) are described, and the advantages and disadvantages of the different methods are outlined. The specific activity and biological and immunological properties of the labeled end products are discussed. The review presented should enable the individual investigator to choose the appropriate method of labeling according to his specific requirements. (auth)

34008 PRINCIPLES FOR THE ASSESSMENT OF THE RELIABILITY OF RADIOIMMUNOASSAY METHODS (PRECISION, ACCURACY, SENSITIVITY, SPECIFICITY). Midgley, A. Rees Jr.; Niswender, Gordon D.; Rebar, Robert W. (Univ. of Michigan, Ann Arbor). Acta Endocrinol., Suppl.; 63: No. 142, 163-84(1969).

From 1st Symposium on Immunoassay of Gonadotrophins, Stockholm, Sweden. See CONF-690946.

An attempt to formulate working definitions and principles by which the reliability of a given radioimmunoassay can be evaluated and compared with other radioimmunoassays is presented. Statistical methods for the analysis of radioimmunoassay data are presented. The feasibility of utilizing the logit transformation was tested empirically, and the advantages which accrue from analyzing data in this fashion are considered. The statistical transformations take into account the heteroscedasticity of the error inherent in a radioimmunoassay and the nonhomogeneity extant in the confidence intervals about the estimates of the values of individual samples. By defining sensitivity as the smallest quantity of unlabeled hormone which can be measured with statistical certainty, and precision as the error in the determination of a hormone concentration at each particular point along the standard inhibition curve, it becomes possible to compare established assays in a meaningful fashion. Minimal criteria for establishing specificity, here regarded as freedom from interference by unwanted substances, are presented. Problems in the evaluation of relative and absolute accuracy are also discussed. (auth)

34009 RADIOIMMUNOASSAY OF FOLLICLE-STIMULATING (FSH) AND LUTEINIZING (LH) HORMONES BY CHROMATOELECTROPHORESIS. Saxena, Brij B.; Leyendecker, Gerhard; Chen, Weiyu; Gandy, Hortense M.; Peterson, Ralph E. (Cornell Univ., New York). Acta Endocrinol., Suppl.; 63: No. 142, 185-206(1969).

From 1st Symposium on Immunoassay of Gonadotrophins, Stockholm, Sweden. See CONF-690946.

Procedure for the radioimmunoassay of FSH and LH using chromatoelectrophoresis for the separation of antibody-bound and free labeled hormone is described. Diurnal variation in FSH and LH levels of normal men and women in follicular and luteal phases of the cycle is reported. The diurnal variation was not abolished in three women taking contraceptive medication and in two women in postmenopause. The diurnal variation of FSH and LH in plasma is compared with that of cortisol, dehydroepiandrosterone and testosterone. It is suggested that diurnal variation of FSH and LH may be independent of a normally functioning pituitary-gonadal axis; however, steroidal feedback may have a regulatory effect on the magnitude of the diurnal variation. The plasma levels of FSH and LH in normal subjects during normal menstrual cycles as well as in patients with endocrinopathies obtained in our laboratory by radioimmunoassay are compared with those obtained by both radioimmunoassay and bioassay of other investigators. (auth)

34010 RADIOIMMUNOASSAYS EMPLOYING IMMUNOSORBENTS. Wide, Leif (Univ. Hospital, Uppsala). Acta Endocrinol., Suppl.; 63: No. 142, 207-21(1969).

From 1st Symposium on Immunoassay of Gonadotrophins, Stockholm, Sweden. See CONF-690946.

The use of a reaction between compounds in a two phase system (a solid phase and a liquid phase) simplified the technical procedure of the radioimmunoassays. Antigens or antibodies can be coupled covalently to insoluble polymers to form stable conjugates with retention of immunological binding capacity. Such imunosorbents can be used in radioimmunoassays in many different ways and with the solid phase in different forms. Some of these techniques seem to be universally applicable for the assay of antigens or antibodies. In one of these, antigens or antibodies are chemically coupled to cyanogen bromide activated insoluble polysaccharides in a particle form. This method which has several advantages when compared with most other radioimmunological methods is discussed in particular. Finally, a detailed description of the preparation of an immunosorbent and its use in such a radioimmunoassay system is given. (auth)

34011 RADIOIMMUNOASSAY WITH ANTIBODY-COATED DISCS AND TUBES. Catt, K. J. (Monash Univ., Melbourne). Acta Endocrinol., Suppl.; 63: No. 142, 222-46(1969).

From 1st Symposium on Immunoassay of Gonadotrophins, Stockholm, Sweden. See CONF-690946.

The measurement of polypeptide hormones by radioimmunoassay was facilitated by the introduction of solid-phase antibody preparations that permit the separation of bound and free tracer to be performed by a rapid washing step. The solid-phase radioimmunoassay technique originally employed substituted powders as the solid-phase, and more recently, antibody-coated discs and tubes were used. The observation that standard plastic tubes would adsorb an appropriate quantity of antibody for use in radioimmunoassay allowed the development of an extremely simple method, in which the assay is performed in plastic counting tubes coated with specific antibody. Antibody-coated tube assays have been established for the measurement of HGH, HCS, HLH, ovine LH, ovine prolactin and other hormones. Recent observations on the use of coated-tube assays for the estimation of gonadotrophic hormones in human and ovine plasma are described, and the temporal relationship between estrogen secretion and LH release is presented. The coated-tube assay procedure is simple, rapid and reliable, and is of general application to the assay of ligands such as antigens, steroids and other molecules with specific binding proteins. (auth)

34012 RADIOIMMUNOASSAYS EMPLOYING DOUBLE ANTIBODY TECHNIQUES. Midgley, A. Rees Jr.; Rebar, Robert W.; Niswender, Gordon D. (Univ. of Michigan, Ann Arbor). Acta Endocrinol., Suppl.; 63: No. 142, 247-56(1969).

From 1st Symposium on Immunoassay of Gonadotrophins, Stockholm, Sweden. See CONF-690946.

Double antibody methods are applicable to all radioimmunoassay systems. At least three approaches exist. The first, in which immunoprecipitating serum is used to precipitate soluble antigen-antibody complexes, is the most commonly used. Since the effects of interfering factors, especially those present in serum, become minimal as equilibrium is approached, care must be taken to ensure that the period of incubation is of sufficient length for the immunoprecipitation reaction to reach equilibrium. In general, all efforts should focus on achieving reaction conditions which maximize stability and optimize immunoprecipitation. A second approach involves use of the first antiserum in an insolubilized form after prior precipitation with the immunoprecipitating antiserum. This approach is attractive since most nonspecific factors cannot interfere with the immunoprecipitation step to a significant extent once the formation of antigen-antibody aggregates is well underway. The third approach, in which immunoprecipitating antiserum is conjugated to a solid matrix, in principle represents a more ideal method of separating bound hormone from free. If this approach is ever to be utilized, a method of conjugating antiserum to a suitable matrix such that the antibody retains most of its immunoreactivity must be devised. (auth)

34013 RADIOIMMUNOASSAY EMPLOYING POLYMERIZED ANTISERA. Donini, S.; Donini, P. (Istituto Farmacologico

Serono, Rome). Acta Endocrinol., Suppl.; 63: No. 142, 257-78(1969).

From 1st Symposium on Immunoassay of Gonadotrophins, Stockholm, Sweden. See CONF-690946.

Antisera made insoluble by polymerization were used for the radioimmunoassay of FSH and LH, as this was shown to be a useful method of separating bound and free labeled hormone. Highly purified HCG and FSH, prepared in this laboratory from urinary source, were labeled with ^{125}I. Anisera were raised by injecting urinary materials. The specificity of antisera was studied and some cross-reactivity was found between anti-urinary FSH and LH, but not with HCG. The sensitivity of LH and FSH radioimmunoassay was 1 mIU/ml and 3 mIU/ml, respectively. Some determinations in dialyzed urine from various sources were also performed and the preliminary results obtained are compared to those previously reported by others. The radioimmunoassay of FSH and LH using a new solid-phase method, i.e., the use of polymerized antiserum, is discussed. (auth)

34014 CHEMICAL PRECIPITATION TECHNIQUES FOR THE RADIOIMMUNOLOGIC QUANTITATION OF GONADOTROPHINS WITH SPECIAL REFERENCE TO THE ORGANIC SOLVENT DIOXANE. Thomas, K.; Nash, D.; Ferin, J. (Univ. Hospital, Louvain, Belg.). Acta Endocrinol., Suppl.; 63: No. 142, 279-99(1969).

From 1st Symposium on Immunoassay of Gonadotrophins, Stockholm, Sweden. See CONF-690946.

A brief survey of the literature reveals that, for the radioimmunoassay of hormones, separation of free from antibody-bound hormone was accomplished by increasing salt concentration (salting-out), precipitation with organic solvents (primary ethanol), or combinations of both. The application of these techniques was most successful with hormones in a relatively low protein milieu such as urine or buffers (standard curve analysis) but are somewhat limited for use on high protein mixtures such as plasma or serum. A detailed account of a technique involving precipitation of hormone-antibody complexes with the organic solvent dioxane is given. This technique has been most successfully applied to the quantitation of luteinizing hormone (LH) in plasma as well as in urine. A discussion of the problems encountered due to the specificity of the antibody and purity of tracer antigens (hormones), in the radioimmunoassay procedure for luteinizing hormone, is included. (auth)

Metabolism, Physiology, and Toxicology

Refer also to abstracts 34179, 34189, 34231, 34233, 34234, 34295–34301, 34306, 34312, 34504, 34524, 34610, 34616–34623, 34625, 34626, 34641, and 34721.

34015 (ACRH-1000-173) NUCLEIC ACID CHANGES AND NUCLEAR RNA POLYMERASE ACTIVITY IN EXPERIMENTAL CARDIAC HYPERTROPHY. Nair, K. G.; Grove, D.; Zak, R.; Cutilletta, A.; Rabinowitz, M. (Chicago Univ., Ill. Argonne Cancer Research Hospital, Chicago, Ill.). [1968]. 22p. (CONF-690833-1). Dep. CFSTI.

From Symposium on Cardiac Hypertrophy, Burlington, Vt.

Cardiac hypertrophy was produced by banding the ascending aorta of a mature female rat with a silver clip. The heart weight, DNA content, and RNA content of the left ventricle were increased by 20 to 50% within 48 hrs. Within 24 hrs after banding an increase in the RNA content of the left ventricle was observed, and on the second day a maximal total ventricular RNA content occurred. A plateau value was maintained for about two weeks, and a fall in RNA occurred a few months later. The radioactivity profile and the optical density pattern of the left ventricular RNA synthesized during a one-hour pulse of ^{32}P was analyzed by sucrose density gradient centrifugation. It was shown that there was an increase in RNA polymerase activity within 12 hrs following aortic banding. Peak activity with a 40% increase over that of controls occurred in two days. A detailed biochemical and cellular study of the organization of growth during myocardial hypertrophy showed that the DNA content of the heart increased with growth but that nearly all of the DNA increase could be accounted for by proliferation of the connective tissue cells and other nonmuscular elements such as the endothelium. (H.L.W.)

34016 (AD-701190) INCORPORATION AND CONTROL OF STRONTIUM, CESIUM, AND IODINE SECRETION IN MILK. Final Report, April 5, 1968–July 31, 1969. Comar, Cyril L.; Wentworth, Richard A.; Lengemann, Fredrich W. (New York State Veterinary Coll., Ithaca. Dept. of Physical Biology). Jul 1969. Contract N00228-68-C-1445. 68p. CFSTI.

Experimental verification of a method for the prediction of the total intake of ^{137}Cs, ^{90}Sr and ^{131}I from milk by average members of human populations following deposition of fallout on pasture is presented. The method was expanded to account for extended and multiple depositions and delays in pasturing cows. As a dietary countermeasure against radiostrontium secretion into milk sodium alginate was about twice as effective as aluminum phosphate gel. Ferric ferrocyanide fed to cows produced over a 90% reduction in ^{137}Cs in milk. (auth)

34017 (BNWL-1050(Pt.1), pp 3.1-66) INHALATION STUDIES. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

From Pacific Northwest Laboratory annual report for 1968 to the USAEC Division of Biology and Medicine. Vol. I. Life sciences. Pt. 1. Biological sciences.

A large number and a wide variety of reports on inhalation studies are included in this section. Three reports are concerned with pathologic effects in beagles of PuO_2 inhalation: the current status of the chronic effects experiment, now 10 years in progress; results of acute toxicity studies with ^{238}Pu; and indications of a possible association between effects of radiation on immune response and tumor development. Four reports are concerned with comparisons of the metabolic behavior of three isotopes of plutonium, ^{237}Pu, ^{238}Pu, and ^{239}Pu, and of ^{241}Am with ^{238}Pu and ^{240}Pu. The role of phagocytic cells in the distribution of particulate Pu was studied following intraperitoneal injection and inhalation of PuO_2. Three reports describe these studies, and a fourth applies the results to the development of a model for determining the distribution of α energy around deposited $^{238}PuO_2$ particles. Several years retention data are reported for inhaled ruthenium oxide in dogs; also data on the retention of uranium oxide and on the metabolic fractionation of different members of the uranium decay chain. Plans are described for a major chronic exposure study of uranium mine atmosphere pollutants employing hamsters and beagles; this is a project which receives partial support from the National Institute for Environmental Health Sciences, Department of Health, Education, and Welfare. Two reports deal with the biochemistry of lung subcellular fractions. (auth)

34018 (LF-41, pp 82-7) RELATIONSHIP BETWEEN PARTICLE SIZE AND RESPIRATORY DEPOSITION OF ^{140}La-LABELED AEROSOLS IN THE BEAGLE DOG. Cuddihy, R. G.; Kanapilly, G. M.; Raabe, O. G. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.).

Initial respiratory deposition patterns of inhaled ^{140}La-labeled aerosols ranging in size from 0.55 to 2.45 μ activity median aerodynamic diameter (AMAD) were measured in five beagle dogs. The fraction of the inhaled aerosols deposited in the nasopharyngeal, tracheobronchial, and pulmonary regions of the respiratory tract were compared and found similar to the position fractions for man based upon the suggestions of the Task Group on Lung Dynamics of the International Commission on Radiological Protection. Over the indicated range of aerosol particle sizes, mean total body deposition ranged from 30 to 75%, mean pulmonary deposition between 20 and 40%, mean tracheobronchial deposition from 3 to 6%, and nasopharyngeal deposition between 5 and 40%. It was concluded that the beagle dog represents a satisfactory biological model for the human with respect to the initial deposition of inhaled aerosols between 0.55 and 2.45 AMAD. (auth)

34019 (LF-41, pp 88-93) AN AUTORADIOGRAPHIC STUDY OF THE DISTRIBUTION OF INHALED RADIONUCLIDES IN THE RESPIRATORY TRACT OF THE BEAGLE DOG. Barnes, J. E. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.).

Autoradiography was used to investigate the distribution of inhaled radioactive aerosols along the respiratory tract of beagle dogs. In the nose, the aerosols accumulated just inside the nares and in the turbinates. Radioactivity also accumulated on the dorsal and ventral surfaces of the nasal-pharynx where the airway bends sharply ventral. Autoradiographs of transverse and longitudinal sections of the thorax showed an inhomogenous distribution of activity following inhalation of an ^{90}Y fused clay aerosol. An observation of variations in radioactivity near the pleural surface of excised lungs revealed a pattern of striations apparently related to the ribs. The biological significance of this pattern of activity was illustrated by the response observed in the pleura and sub-pleural tissues of the lung in a dog exposed to an aerosol containing ^{241}Am. (auth)

34020 (LF-41, pp 94-100) A MODEL FOR THE BEHAVIOR OF LABELED FUSED CLAY PARTICLES FOLLOWING INHALATION BY RATS. Thomas R. G. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.).

Montmorillonite clay particles were labeled with ^{137}Cs and passed through a heating column at 1150°C. Fifteen rats exposed by inhalation to the resulting aerosol received whole-body burdens of 5 to 15 μCi. Whole-body counting at closely spaced intervals resulted in a retention pattern that could be described by either a two-term power function or a three-term exponential, out to

600 days post-exposure. An exponential model has been designed that describes this retention in terms of amounts leaving the respiratory tract either by clearance through the gastrointestinal tract or by other mechanisms of removal to lymph nodes and blood. Analogies are made, based upon model parameters, that infer that dissolution characteristics of the fused clay in body fluids are very similar to the known properties of glass. (auth)

34021 (LF-41, pp 105-10) RETENTION AND DISTRIBUTION OF ^{137}Cs IN THE BEAGLE DOG FOLLOWING INHALATION OF ^{137}Cs IN FUSED MONTMORILLONITE CLAY PARTICLES. Boecker, B. B.; McClellan, R. O.; Scott, J. K. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.).

To aid in evaluating the retention and distribution of a relatively insoluble radioactive material such as might be released in certain nuclear accidents, 30 beagle dogs were given single, 15-minute exposures to aerosols of fused montmorillonite clay particles containing ^{137}Cs. The AMAD (activity median aerodynamic diameter) for the aerosols ranged from 1.5 to 2.7 μ among different exposures (σ_g was 1.6 to 1.8). Approximately 60% of the initial body burden was excreted within the first three days, primarily in the feces. The whole-body retention of ^{137}Cs remaining after this early clearance had a mean biological half-life of over 400 days for dogs still living beyond two years post-exposure. To date, dogs were serially sacrificed throughout the first two years postexposure. Although over 90% of the body burden at eight days postexposure was in the lung and tracheobronchial lymph nodes, some ^{137}Cs was found to be generally distributed throughout the body in tissues such as muscle, liver, kidneys, and bone. Kinetics of these distribution data are discussed. (auth)

34022 (LF-41, pp 111-16) TISSUE DISTRIBUTION, EXCRETION, AND DOSIMETRY OF INHALED ^{106}Ru CITRATE IN THE BEAGLE DOG. Boecker, B. B.; Harris, A. M. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.).

Investigations on the biological behavior of inhaled ^{106}Ru citrate and its resultant radiation dose patterns are being performed in the beagle dog. Thirty beagle dogs 13 to 16 months of age were given single, 10-minute inhalation exposures to an aerosol of ^{106}Ru citrate. The postexposure protocol included whole-body counting, excreta collections, and serial sacrifice in groups of three for tissue distribution determinations. A large percentage of the initial body burden (≈80%) was excreted during the first three days. There was a continual decrease in the rates of ^{106}Ru excretion in both urine and feces with increasing time postexposure but excretion via urine normally exceeded that in feces by a factor that ranged from 3 to 10. The mean whole-body retention curve for three dogs sacrificed at 512 days postexposure was fitted with four exponential components whose percentages of the initial body burden at the zero-time intercepts and effective half-lives were 80%, 0.6 day; 13%, 11 days; 4%, 53 days; and 3%, 280 days, respectively. Highest concentrations of ^{106}Ru were found in the lung followed by ribs, kidneys, femur, skin, liver, spleen, and muscle. Radiation insult to the lung for this nuclide and chemical form is compared with results obtained for other radionuclides and chemical forms at this laboratory. (auth)

34023 (LF-41, pp 117-20) TISSUE DISTRIBUTION OF ^{99}Mo IN THE BEAGLE DOG AFTER INHALATION OF AEROSOLS OF VARIOUS CHEMICAL FORMS. Cuddihy, R. G.; Boecker, B. B.; Kanapilly, G. M. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.).

The tissue distribution of ^{99}Mo was studied in the beagle dog after inhalation of ammonium molybdate, molybdenum chloride, and molybdenum oxide aerosols containing ^{99}Mo. Eight days after inhalation of ammonium molybdate and molybdenum chloride, less than 6% of the total-body activity was found in lung, whereas after inhalation of molybdenum oxide aerosols 46% of the retained activity was found in the lung. Liver, skeleton, muscle, and kidney contained the greatest amount of the ^{99}Mo activity absorbed into the general circulation and the distribution of activity among these tissues was similar in all experiments. Radiation doses to nasal turbinate, lung, liver, and kidney tissues were found to be the most significant after inhalation of ammonium molybdate and molybdenum chloride aerosols. After inhalation of molybdenum oxide aerosols, radiation doses to lung tissue appeared to be about a factor of 10 greater than for other tissues. (auth)

34024 (LF-41, pp 121-9) SOME STUDIES ON THE BEHAVIOR OF INTRAVENOUSLY INJECTED AND INHALED ^{95}Nb(V) OXALATE IN THE BEAGLE DOG. Kanapilly, G. M.; Cuddihy, R. G.; Pillow, W. W. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.).

The behavior of ^{95}Nb was investigated in the beagle dog following intravenous injection or inhalation of ^{95}Nb(V) oxalate with special attention directed to the binding of ^{95}Nb by blood proteins. In three dogs, a large fraction of the inhaled ^{95}Nb was deposited in the upper respiratory tract and cleared rapidly via the gastrointestinal tract. The activity absorbed into the general circulation was retained with a pattern similar to that observed for three dogs given ^{95}Nb intravenously. For the latter dogs, approximately 20% of the injected ^{95}Nb was excreted in the urine the first day, with small quantities excreted in the urine on other days. In two additional dogs given ^{95}Nb intravenously, 70% of the ^{95}Nb was excreted in the urine on the day of injection. Fecal excretion of injected ^{95}Nb was low throughout the study in all dogs. At 30 days after injection most of the ^{95}Nb was present in liver, skeleton, muscle, and kidney with the ratio of skeletal to liver ^{95}Nb being 1.6 for 3 dogs and 3.5 for the 2 dogs with high early urinary excretion of ^{95}Nb. In the dogs that inhaled ^{95}Nb, the tissue distribution was similar to that of the former 3 injected dogs with the exception that lung contained about twice as much ^{95}Nb as liver. The transport of ^{95}Nb in the general circulation appeared to be in association with alpha globulins. About 10% of the blood ^{95}Nb was found to be associated with components of blood clotted material, about 70% was found to be bound to blood serum protein identified as alpha globulin and the remaining 20% was either ionic or associated with small molecules of less than 50,000 molecular weight. (auth)

34025 (LF-41, pp 130-5) RETENTION AND TISSUE DISTRIBUTION OF ^{171}Tm IN THE RAT FOLLOWING INTRAVENOUS INJECTION OF $^{171}TmCl_3$. Thomas, Randi L.; Kingsley, Barbara L. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.).

Rats were intravenously injected with $^{171}TmCl_3$, receiving initial body burdens of 50 or 100 μCi per animal. Substantial excretion of the material during the first 24 hr after injection was followed by small subsequent losses with approximately 60% of the initial body burden remaining two months after injection. Radiothulium concentrated in skeleton, kidneys, and liver, initially, with subsequent losses from all organs but skeleton, where approximately 89% of the sacrifice body burden was concentrated at 64 days after injection, with a biological half-time of retention estimated to be 1200 days. (auth)

34026 (LF-41, pp 136-46) ANALOG SIMULATION OF THE BIOLOGICAL BEHAVIOR OF INHALED RADIONUCLIDES. Cuddihy, R. G. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.).

An analog computer facility is described that includes a Systron-Donner Model SD 80 Analog Computer and various other peripheral components. The applications of the capabilities of this system for data analysis are outlined and a biological model for describing the movements of inhaled radionuclides in the beagle dog is discussed. (auth)

34027 (LF-41, pp 203-8) METABOLISM AND TOXICITY OF ^{241}Am IN THE CHINESE HAMSTER. McKay, L. R.; Brooks, A. L.; McClellan, R. O. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.).

Chinese hamsters were injected with 1.0 μCi ^{241}Am citrate and sacrificed at 1, 2, 4, 8, and 16 days postinjection to assess the tissue distribution and radiation dose. Whole-body retention of the isotope at 16 days was approximately 70% of the injected activity. At that time, liver, skeleton, and kidneys contained 53%, 22%, and 1% of the initial body burden, respectively. A second series of hamsters was injected intraperitoneally with 0.3, 1.0, and 3.0 μCi ^{241}Am citrate and maintained with 16 controls for long-term observation. The median survival time of the animals that received 3.0 μCi ^{241}Am was 36 days. No deaths were observed (to 45 days) in the hamsters that received 1.0 μCi or less. Cytogenetic studies on the liver of animals partial-hepatectomized at various times after administration of ^{241}Am are currently under way. (auth)

34028 (SWRHL-27-r) STUDY OF A SINGLE DOSE ^{131}I-^{126}I RATIO IN DAIRY COWS. Shimoda, W.; Black, S. C.; Falter, K. H.; Engel, R. E.; Barth, D. S. (Public Health Service, Las Vegas, Nev. Southwestern Radiological Health Lab.). Apr 1970. 100p. Dep. CFSTI.

Four groups of two lactating Holstein cows each were dosed in single ingestion experiment with four different combinations of ^{126}I and ^{131}I ranging from 0 to 20.1% ^{126}I. Theoretical equations developed and experimental results indicate that it is possible to detect and quantitate ^{126}I in the presence of ^{131}I in milk samples by determining the physical half-life of the combined radioiodines from repetitive γ scans on the same samples, even though the individual γ energies of ^{126}I and ^{131}I cannot be resolved by the γ analysis system. Peak levels of the radioiodines in milk from all cows were observed at five hours (first milking) after oral ingestion of dose. Subsequently, milk exhibited an effective half-life (T_{eff}) ranging from 12.5 to 18.0 hours with an average value of 14.4

hours. Calf thyroid percent uptake from ingestion of milk contaminated with radioiodine ranged from 8.4 to 13.2% with an average of 11.15%. The T_{eff} in calf thyroids ranged from 5.74 to 9.55 days with an average of 7.46 days. The recoveries of radioiodine from milk by use of ion-exchange column and AgI precipitation methods, when compared to γ scans of whole milk, had large standard deviations indicating further experimentation with these methods is desirable prior to field use. (auth)

34029 (UCB-34-P-23-X-1) SOIL CHEMISTRY OF RADIOISOTOPES. Technical Summary, 1968-1969. (California Univ., Berkeley). 41p. Dep. CFSTI.

The effects of soil pH on the uptake of ^{106}Ru by ladino clover grown in the greenhouse on two different soil types were studied. The uptake and translocation of ^{137}Cs, ^{106}Ru, and ^{85}Sr by browse plants (Ceanothus and Adenostema) was studied following addition of the radioisotopes to culture solutions. The effects of internal β radiation on the development of dwarf pea plants were studied following the addition of ^{32}P or ^{85}Sr to culture solutions. At the higher levels permanent damage was observed and fruit production was eliminated. Micro thermoluminescent dosometers consisting of CaF_2: mn chips sealed in black polyethylene film were developed for use for β dosimetry in soil. Field plots contaminated with ^{90}Y fused to quartz sand particles were prepared to assess β radiation damage to field crops contaminated by fallout. Preliminary results are reported for lettuce and wheat. (C.H.)

34030 (UCRL-19420) BIOLOGY AND MEDICINE SEMIANNUAL REPORT, FALL 1969. Lawrence, John H. (ed.) (California Univ., Berkeley. Lawrence Radiation Lab.). Contract W-7405-eng-48. 106p. Dep. CFSTI.

Separate abstracts were prepared on eight sections of this report. Seven additional sections report the results of basic and clinical metabolic studies. (C.H.)

For abstracts of individual papers see: 33707, 33708, 33989, 33990, 34319-34321, and 34427.

34031 BONE CANCER INDUCED BY INTERNALLY-DEPOSITED EMITTERS IN BEAGLES. Dougherty, T. F.; Mays, C. W. (Univ. of Utah, Salt Lake City). Contract AT(11-1)-119. pp 361-7 of Radiation-Induced Cancer. Vienna; International Atomic Energy Agency (1969).

From Symposium on Radiation-Induced Cancer, Athens, Greece. See STI/PUB-228; CONF-690404.

Osteosarcomas have been the chief cause of death in adult beagles injected intravenously with bone-seeking radionuclides in citrate solution. The effectiveness of each nuclide depends on the type of radiation emitted and where this radiation is absorbed. Alpha-radiation is more effective than beta radiation, and the alpha emitters which deposit on bone surfaces are more effective than those which deposit throughout bone volume. For death with osteosarcomas 8 years after injection, values for RBE (relative biological effectiveness) based on average skeletal dose at 1 year before death and relative to ^{226}Ra = 1 are: ^{239}Pu = 6; ^{228}Th = 8; ^{228}Ra (MsTh) = 2.5; and ^{90}Sr = 0.07 to 0.24. In humans ^{226}Ra has been observed to induce bone cancers above a skeletal dose of about 1200 rads. Adjusting by the RBE factors established in dogs, the predicted lifetime doses above which bone cancers may occur in adult humans are: ^{239}Pu = 200 rads; ^{228}Th = 150 rads; ^{226}Ra = 480 rads; ^{228}Ra = 1200 rads; and ^{90}Sr = 5000 to 17,000 rads. (auth)

34032 TOXICITY OF ^{226}Ra IN MICE. Finkel, Miriam P.; Biskis, B. O.; Jinkins, P. B. (Argonne National Lab., Ill.). pp 369-91 of Radiation-Induced Cancer. Vienna; International Atomic Energy Agency (1969).

From Symposium on Radiation-Induced Cancer, Athens, Greece. See STI/PUB-228; CONF-690404.

To obtain information on the long-term effects of radionuclides for use in assessing the hazard in the event of human exposure, an experimental plan was designed with radium toxicity serving as the basis for comparing the effects of various radionuclides in the mouse, and as the link between mouse and man, an approach made possible by the existence of a number of individuals with radium burdens. The main features of the experimental design were the use of 70-day-old CF1 female mice treated with a single intravenous injection of the radionuclide. The mice were permitted to live until moribund, and each underwent postmortem examination and roentgenographic examination of the skeleton. Tissues were taken for histological examination when necessary to determine the nature of the terminal illness or to verify the presence of tumor. The major radium-toxicity experiment consisted of 3210 mice; the amount of ^{226}Ra injected ranged from 0.05 to 120 μCi/kg. Radiation damage in bone and the induction of bone sarcoma were the most conspicuous consequences of the radium injections. Of the two, bone sarcoma proved to be the more sensitive indicator of radium toxicity since tumors appeared at exposure-doses that did not produce other histological evidence of damage. The incidence of bone sarcoma was significantly greater in the 0.25 μCi/kg exposure group than in the control group, and the tumor response decreased linearly as the amount of radium injected decreased to 0.05 μCi/kg. The time to radiographic appearance of the tumors was estimated on the basis of tumor size at death, and the resulting data were examined to determine whether latent period to radiographic appearance was associated with exposure dose. (auth)

34033 PRODUCTION OF OSTEOSARCOMAS IN MICE AND RATS BY INCORPORATION OF ^{224}Ra. Hug, O.; Goessner, W.; Mueller, W. A.; Luz, A.; Hindringer, B. (Gesellschaft fuer Strahlenforschung, Neuherberg, Ger.). pp 393-409 of Radiation-Induced Cancer. Vienna; International Atomic Energy Agency (1969).

From Symposium on Radiation-Induced Cancer, Athens, Greece. See STI/PUB-228; CONF-690404.

The effect of incorporated ^{224}Ra has been investigated in mice and rats. The 3 to 4 week old mice received 5 to 200 μCi/kg body weight intraperitoneally as single doses and higher amounts as fractionated doses. Distribution and excretion studies lead to the calculated average skeleton dose of 28 rads/μCi/kg and an initial dose-rate of 8 rads/day and μCi/kg. So far about 6% of the 2506 experimental mice have developed osteosarcomas. The incidence was higher in the females than in the males. The shortest latency time was 5 months and the maximum incidence occurred at 17 to 18 months. No sarcomas were observed in the control animals. In some animals sarcomas appeared after doses of only 5 μCi. The optimum doses for tumor production were 50 to 100 μCi/kg. In 138 Wistar rats, which received 5 to 40 μCi of ^{224}Ra/kg, 26 bone tumors have been observed so far. Besides mortality and tumor incidence the pathogenesis of late effects was followed by histological and histochemical studies. These studies show that a short-lived radioisotope may produce osteosarcomas. The experimental data are in good agreement with the clinical observation of osteosarcoma in man after treatment with ^{224}Ra in childhood. (auth)

34034 THE UPTAKE OF PERTECHNETATE BY THE VAGOTOMIZED RAT STOMACH. A PRELIMINARY REPORT. Eliscu, Edward H.; Potsaid, Majic S.; Lo, Hing Har (Harvard Medical School, Boston. Massachusetts General Hospital, Boston). Radiology; 94: 699-701 (Mar 1970).

Experiments with rats revealed no significant difference in uptake to pertechnetate by the gastric mucosa with and without vagotomy, despite evidence of increased uptake in man following vagotomy as noted by other authors. These conflicting results may be the result of the relatively short time interval employed in these experiments. (auth)

34035 FIELD LOSS OF RADIONUCLIDES FROM GRASS. Chadwick, R. C.; Chamberlain, A. C. (Atomic Energy Research Establishment, Harwell, Eng.). Atmos. Environ.; 4: 51-6 (Jan 1970).

Solutions of ^{85}Sr, ^{51}Cr, and ^{210}Pb were sprayed onto grassland, and the initial retention by the herbage and subsequent rate of field loss by weathering were measured. A similar experiment was also done with a spray containing a suspension of 1 μm diameter polystyrene particles, tagged with ^{51}Cr in insoluble form. The activity initially retained by the herbage was on average 40 per cent of that applied in the spray. The subsequent field loss corrected for radioactive decay gave retention half lives of ^{85}Sr as chloride of about 19 days in summer and 49 days in winter. The rate of loss of ^{51}Cr as chromate was not greatly different from that of ^{85}Sr, and similar results also were obtained in the single experiment with tagged particles, but the rate of field loss of ^{210}Pb appeared to be somewhat less. (auth) (UK)

34036 EFFECTS OF POTASSIUM, ACETYLCHOLINE, CARBACHOL, AND HISTAMINE ON ^{22}Na MOVEMENTS IN ILEAL SMOOTH MUSCLE. Weiss, George B. (Medical Coll. of Virginia, Richmond). J. Pharmacol. Exp. Ther.; 170: 123-31 (Nov 1969).

Effects of several stimulatory agents upon ^{22}Na uptake in longitudinal smooth muscle isolated from guinea-pig ileum were measured. The ^{22}Na uptake was not altered by raising the K concentration of the Tyrode's solution to 80 mM but was markedly increased by substitution of K^+ for the nonradioactive Na^+ in the bathing solution. The largest increases in ^{22}Na uptake obtained with acetylcholine, carbachol, or histamine occurred when muscles were incubated in ^{22}Na prior to a brief exposure to one of these stimulatory agents. The increased ^{22}Na uptake was seen mainly as part of the slow washout component. An increase in total Na^+ content was also induced by acetylcholine, carbachol, and histamine. The magnitude of contractile responses to various

stimulatory agents was not inhibited either by ouabain (even though muscle Na^+ content was increased) or by substitution of K^+ for Na^+. The ^{22}Na movements and changes in cellular Na^+ gradients could be dissociated from tension responses under some conditions. Thus, ^{22}Na movements and contractions induced by stimulatory agents may not always occur in sequence in ileal smooth muscle but, instead, can be parallel and largely independent cellular responses. (BBB)

34037 EFFECT OF CHELATING AGENTS ON THE AVAILABILITY TO PLANTS OF CARRIER-FREE ^{59}Fe AND ^{65}Zn ADDED TO SOILS TO SIMULATE CONTAMINATION FROM FALLOUT. Wallace, A.; Mueller, R. T. (Univ. of California, Los Angeles). Contract AT(11-1)-34. Soil Sci. Soc. Amer., Proc.; 33: 912-14 (Nov-Dec 1969).

Carrier-free ^{59}Fe and ^{65}Zn were added to Dinuba fine sandy loam (neutral), Hacienda loam (calcareous), and Yolo loam (slightly acid), and equilibrated through drying and wetting cycles. Bush bean (Phaseolus vulgaris L., var. "Improved Tendergreen"), corn (Zea mays L., var. "Golden Cross Bantam"), and soybean (Glycine max Merr., var. "PI-54619-5-1" and "Hawkeye") were grown in ^{59}Fe-containing soil and bush bean (P. vulgaris L.), corn (Z. mays L.), and cotton (Gossypium hirsutum L., var. "Acala 442") were grown in ^{65}Zn-containing soil. One-half of those with ^{59}Fe received Na_2EDDHA equivalent to 4.4 kg of Fe/ha had there been a 1:1 metal chelate and one-half of those with ^{65}Zn received Na_2EDTA equivalent to 5.5 kg of Zn/ha had metal been added with the chelating agent. The chelating agents had many different effects depending on soil and on crop. Chelating agents increased the specific activity of ^{59}Fe in the bush bean and soybeans. The specific activity of ^{59}Fe in corn was unchanged by chelating agent but was much higher than in bush bean and soybean with or without chelating agents. When carrier Fe was added, the behavior of ^{59}Fe was essentially unchanged. The specific activity of ^{65}Zn in plants in most cases was increased by the EDTA. The EDTA increased both ^{65}Zn and total Zn in corn, but the specific activity generally was unchanged by the chelate. (auth)

34038 RADIOCALCIUM AND RADIOPHOSPHATE STUDIES AFTER THYROCALCITONIN IN MAN. Caniggia, A.; Gennari, C.; Bencini, M.; Borrello, G. (Univ. of Siena, Italy). Helv. Med. Acta; 35: 96-102(Nov 1969).

The effect of porcine thyrocalcitonin (TCT) on plasma calcium and phosphate, urinary calcium and phosphate, phosphate-clearance and C_P/C_{Cr} ratio, and on the rate of dissapearance of ^{47}Ca and ^{32}P from the circulation was studied in 5 normal subjects and in 5 patients with metabolic or neoplastic bone disease. The fasting patients were given 10 to 25 μCi of ^{47}Ca intravenously. Blood samples were drawn 10 min to 24 hr after radiocalcium injection. Urine samples were collected 2 hr before and 2 hr after TCT infusion. The same experimental procedure was used in radiophosphate studies. A dose of 10 to 30 μCi of radiophosphate (^{32}P as sodium orthophosphate) at elevated sp act. was injected intravenously. TCT was found to be effective in lowering plasma calcium and phosphate and in increasing phosphaturia, phosphate-clearance, and C_P/C_{Cr} ratio; urinary calcium was unaffected. The decline of the plasma sp act. of ^{47}Ca and ^{32}P was halted by TCT infusion. The hypothesis that TCT inhibits bone resorption is proposed. (BBB)

34039 ^{65}Zn IN SUBCELLULAR FRACTIONS OF RAT TISSUE. English, Robert Alan Ann Arbor, Mich.; Univ. of Michigan (1969). 133p.

Thesis.

Calculation of radiation dose from ingested radionuclides requires knowledge of radionuclide distribution and rates of elimination from critical tissues. This investigation was performed to determine subcellular distribution and elimination characteristics of zinc-65. Female albino rats were raised under conditions of whole body zinc-65 equilibrium by in utero exposure followed by 140 days of zinc-65 feeding. Tissues and tissue fractions were analyzed for stable zinc, zinc-65, protein and various zinc-binding enzymes as a function of time after cessation of zinc-65 feeding. Sampling intervals ranged from 12 hours to 33 days and covered a span of 158 days. Parameters were determined for the mathematical description of zinc-65 accumulation within the subcellular fractions and their parent whole tissues. Equilibrium concentrations of zinc-65 in fractions of liver, kidney, muscle and blood were not significantly higher than the mean whole body concentration. The contribution to subcellular dose by the Auger electrons of zinc-65 is negligible under these conditions. The major zinc-binding substance of rat muscle appears to be lactic dehydrogenase. Muscle accounted for 45% of the zinc-65 in the rat at equilibrium. Zinc-65 concentration in rat fur reflected whole-rat burden of the isotope. Calculations show that a similar relation should exist between human hair and zinc-65 in the human body. The soft tissues investigated exhibited two component zinc-65 elimination curves over the period of observation. Each curve is described by components with effective half-lives of approximately 7 and 35 days. Indirect evidence indicates the presence of an additional component for blood plasma. This component accounts for 88% of the zinc-binding capacity of plasma, and exhibits a half life of 45 minutes. Zinc-65 elimination from bone is described by a single half-life component of 154 days. Uptake of zinc-65 from the diet by the adult unmated female rats in this investigation was 7%. Uptake by females during pregnancy and lactation was greater than 20%. (Diss. Abstr.)

34040 THE PENETRATION AND ADSORPTION OF CESIUM IN BEAN LEAVES. Levi, E. (EURATOM–ITAL, Wageningen, Netherlands). Acta Bot. Neer.; 18: 455-61(Jun 1969).

The foliar uptake of ^{134}Cs in the leaves of beans (Phaseolus vulgaris) was studied under conditions of varying temperature, humidity, and air flow on the leaf surface. Leaf treatment consisted in applying 0.01 ml aqueous solution of 1 mM $^{134}CsCl$ containing 0.1 μCi ^{134}Cs to the tip of one primary leaf of plants, the first trifoliate of which was expanding. At various times after treatment the fraction of ^{134}Cs not retained by the plant was washed off the treated area and the plant harvested in separate fractions to determine the amount still held in the treated area as well as the distribution of the ^{134}Cs taken up. At constant relative humidity (RH), the air temperature played a role in Cs uptake. One hour after treatment 98.0, 85.6, and 80.0% of the total applied Cs could be removed by washing the treated leaves of plants at 15, 23, and 30°C. The quantity held in the treated area, while very low at 15°C (1.1%) was considerably greater (14.2%) at the optimal temperature of 23°C and still significantly greater at 30°C (19.4%) 1 hr after treatment of the leaves. When the RH was doubled, there was a significant increase in the total Cs taken up in the 6-hr period for each of the temperatures considered. Thus, enhanced penetration was obtained by increasing air humidity or leaf moisture content through a decrease in transpiration. Accumulation and transport followed the same pattern and were influenced more by temperature than by humidity. (BBB)

34041 THE UPTAKE OF APPLIED SELENIUM BY AGRICULTURAL PLANTS. I. THE INFLUENCE OF SOIL TYPE AND PLANT SPECIES. Bisbjerg, B.; Gissel-Nielsen, G. (Danish Atomic Energy Commission, Risoe, Denmark). Plant Soil; 31: 287-98(Oct 1969).

A comparison of plants grown on 6 soils showed that their ability to take up ^{75}Se varied by one order of magnitude when potassium selenate was the source of ^{75}Se and by a factor of 5 when selenite was the source. The uptake of selenate was, on an average, 8 times that of selenite. Five of the 6 soils used were representative of the greater part of the Danish agricultural area while one of them was a special case. The effect of selenium application was found to be much the same in the common soils although the concentration in the plants was sometimes twice as high on sandy as on loamy soils. For most areas concentration of ^{75}Se in the plant was roughly inversely related to the clay content of the soil. The ^{75}Se concentration in the plants varied with their stage of development. In barley the concentration was lower in straw and grain than in the green plant, in mustard it depended on the oxidation state of the Se. Grain and seed, in general, contained more Se than the straw. Of 10 plant species the cereals had the smallest uptake of ^{75}Se. The uptake by red clover seemed to be favored by an excess of available Se while at moderate levels rye grass was a better accumulator than the clover. When the selenate addition was increased by a factor of 25, the plant level of ^{75}Se increased 70 fold; for selenite the factor was 50. The application of 0.1 ppM selenite-Se or somewhat less selenate leads to a useful Se level in plants in pot experiments. (BBB)

34042 BEHAVIOR OF IRON-, INDIUM-, AND IODINE-LABELED TRANSFERRIN IN THE PREGNANT RAT. Graber, Stanley E.; Hurley, Peter J.; Heyssel, Robert M.; McIntyre, Patricia A. (Johns Hopkins Medical Institutions, Baltimore). Proc. Soc. Exp. Biol. Med.; 133: 1093-6(Mar 1970).

Fetal and placental uptakes after administration of ^{59}Fe-, ^{113m}In-, and ^{125}I-transferrins at various stages of gestation in the rat were studied. In the latter third of pregnancy ^{59}Fe went to the fetus in large amounts, but, in contrast, ^{113m}In accumulated in the placenta. Only small quantities of ^{125}I-transferrin reached the fetus, and considerably less ^{125}I than ^{113m}In was found in placenta. It is concluded that transferrin does not carry iron across the placenta and that indium is removed from transferrin by the placenta, but does not cross to the fetus. (auth)

34043 SOME EFFECT OF SOURCE AND LEVEL OF NITROGEN ON THE INCORPORATION OF RADIOACTIVITY FROM ^{14}C GLUCOSE TO RUMEN VOLATILE FATTY ACIDS.

Satapathy, N. (Central Food Tech. Research Inst., Mysore, India). Indian Vet. J.; 46: 886-92(1969).

Rumen contents from two different groups of sheep pre-fed with low or high protein diet were incubated with ^{14}C glucose and two levels of dracket soybean protein, urea or lactalbumin protein hydrolysate. The samples were fractionated into volatile fatty acids by the help of column chromatography. Each VFA fraction was assayed for the radioactivity. The results indicate that supplementation of nitrogen increased the overall uptake of activity to VFA in all samples. Percentage of activity in acetate and propionate fractions showed increasing trend. Percentage of activity in butyrate fraction invariably decreased. (auth)

34044 EARLY INTRACELLULAR EVENTS IN THE REPLICATION OF T4 BACTERIOPHAGE DEOXYRIBONUCLEIC ACID. VII. ^{32}P SUICIDE STABILIZATION. Miller, Robert C. Jr. (Univ. of Pennsylvania, Philadelphia). J. Virol.; 5: 533-5(Apr 1970).

The relation between ^{32}P suicide stabilization and deoxyribonucleic acid (DNA) replication during infection of Escherichia coli by bacteriophage T4 was reinvestigated. Replication of the parental phage DNA was detected at early stages of stabilization. (auth)

34045 DOUBLE-STRAND SCISSIONS IN BACTERIOPHAGE T4 DEOXYRIBONUCLEIC ACID AS A RESULT OF ^{32}P DECAY. Miller, Robert C. Jr. (Univ. of Pennsylvania, Philadelphia). J. Virol.; 5: 536-9(Apr 1970).

Double-strand scissions produced by decay of ^{32}P incorporated into T4 deoxyribonucleic acid (DNA) were detected in cross-linked DNA and DNA containing ^{32}P in only one strand of the double helix. (auth)

34046 ACCUMULATION OF ^{203}Hg BY THE MARINE DIATOM CHAETOCEROS COSTATUM. Glooschenko, Walter A. (Florida State Univ., Tallahassee). J. Phycol.; 5: 224-6(Sep 1969).

This study investigated ^{203}Hg uptake by the neritic marine diatom Chaetoceros costatum to determine the importance of surface adsorption of ^{203}Hg vs active uptake by comparing uptake by dividing, nondividing, and dead cell populations in the light and dark. No difference in ^{203}Hg uptake was seen in nondividing cells in the light and dark while dead cells accumulated about two times as much ^{203}Hg as living cells, presumably by surface adsorption. Dividing cells in light accumulated ^{203}Hg longer than did nondividing cells, indicating the possibility of some active uptake of ^{203}Hg. The exponential accumulation curve of ^{203}Hg for dividing cells of C. costatum is similar to radionuclide uptake curves in algae for other isotopes, e.g., ^{59}Fe in the diatom Phaeodactylum tricornutum, the marine benthic alga Chaetomorpha linum with ^{65}Zn, ^{144}Ce in Nitzschia closterium, ^{106}Ru in Porphyra luciniata and Phaeodactylum tricornutum, and ^{137}Cs by Chlorella. In Chaetoceros, since uptake of ^{203}Hg occurred both in the light and dark, with slightly more in the dark, uptake of ^{203}Hg is not dependent on photosynthesis. (BBB)

34047 ABSORPTION OF ^{64}Cu FROM GASTROINTESTINAL TRACT OF THE RAT. Marceau, N.; Aspin, N.; Sass-Kortsak, A. (Univ. of Toronto. Hospital for Sick Children, Toronto). Amer. J. Physiol.; 218: 377-83(Feb 1970).

The input-discovery method was adapted to measure the initial entry of copper 64 from the gastrointestinal tract into the plasma space of adult male rats. As a first step an impulse-response function was determined by measuring the plasma activity as a function of time following a rapid intravenous injection of ^{64}Cu. Thereafter, operating on the impulse-response function and the plasma response to an oral administration of ^{64}Cu, the rate and extent of initial copper 64 uptake from the gastrointestinal tract were calculated. The system responded linearly to increasing doses of intravenously administered copper up to 9μg per 300-g rat. In the case of oral dosage linearity of the plasma response was maintained from trace up to 12 μg copper per 300-g rat. The response became nonlinear above these doses. The administration of copper in a protein or amino acid-bound form did not change the initial rate of absorption from the gastrointestinal tract, which was the same as for ionic copper 64. (auth)

34048 DYNAMIC EXAMINATION OF THE UPTAKE OF RADIOIODIDINE-131 BY THE THYROID GLAND OF RATS BORN OF HYPOTHYROIDAL MOTHERS. Khomasuridze, A. G. (Inst. of Experimental Endocrinology and Chemistry of Hormons, Moscow). Probl. Endokrinol.; 16: 60-4(Jan-Feb 1970). (In Russian).

The function of thyroid gland of the embryos of hypothyroidal rats was intensified in association with the necessity of supply with thyroid hormones not only of own organism, but also of maternal organism. At the early stages of postnatal development the thyroid gland of such animals absorbed more radioiodine than of ratlings born of intact mothers. At the age of 1 and 4 months there is noted an exhaustion of the thyroid glands of the progeny of hypothyroidal mothers, this being manifested in reduced iodine uptake. The mentioned phenomenon is especially pronounced in experiments with thyrotropic hormone loading. The thyroid gland of old rats absorbs ^{131}I much more intensively than of younger rats. (auth)

34049 INFLUENCE OF COPPER STATUS ON ^{64}C METABOLISM IN THE RAT. Milne, D. B.; Weswig, P. H.; Whanger, P. D. (Oregon State Univ., Corvallis). Biochem. Med.; 3: No. 2, 94-104(1969).

The effect of dietary Cu on the metabolism of injected ^{64}Cu was studied. Three groups of weanling rats that were fed low (1 mmp Cu), recommended (10 ppm Cu), or high Cu (200 ppm Cu) diets for 8 wk were injected intravenously with ^{64}Cu-acetate (50 uCi ^{64}Cu). Blood uptake and liver fractions of the ^{64}Cu were determined after 0.5, 1, 2, 4, and 8 hr. Results revealed that the ^{64}Cu was rapidly removed from the plasma and concentrated in the liver proportional to the Cu status of the rat. In the normal and low Cu groups, there was a subsequent increase in blood activities and a reduction in liver Cu after 4 hr. The increase in blood activity corresponded to an increase in ceruloplasmin activity in rats fed the low Cu ration. The relative distribution of ^{64}Cu in liver fractions of normal rats at all time intervals was as follows: soluble > debris > mitochondria > microsomes. Significant deviations in rats maintained on low and high Cu rations were observed. Pathways for the movement of Cu in the blood and liver are proposed. (C.O.)

34050 THE INFLUENCE OF IODINE IN THYROID IODINE ACCUMULATION AND TURNOVER IN EUTHYROID AUSTRALIAN SUBJECTS. Myhill, J.; Oddie, T. H.; Hales, I. B.; Fisher, D. A. (Univ. of California, Torrance). Acta Endocrinol.; 62: 1-10(Sep 1969).

The metabolism of radioiodine and thyroxine in euthyroid humans on a moderately low dietary intake of iodine, and the effects of exogenous I were compared with results already found for subjects exposed to a high I intake. Using ^{131}I-labeled thyroxine and ^{127}I, the fractional thyroxine degradation rate, total thyroxine turnover, thyroidal secretion of thyroxine, and accumulation of ^{127}I were measured by whole-body counting of 28 euthyroid patients. The measurements were made during the administration of 0, 100, and 200 μg of thyroxine/day in successive 7-week periods, during the administration of 0, 252, and 1009 μg of I daily in successive 13-week periods. When thyroxine was administered, the fall in thyroidal secretion rate paralleled the fall in ^{131}I clearance rate. However, during administration of I, thyroidal ^{131}I clearance fell, without appreciable alteration in total turnover of thyroxine. Thyroid ^{131}I turnover increased progressively with increasing I intake and reached a mean value of 221 μg daily on a mean intake of 1250 μg I daily. The total-body turnover of thyroxine was the quantity maintained in thyroid homeostasis. The most significant effects on thyroid function of a chronic moderate increase in I intake were an inhibition of I-concentrating activity, and an augmentation of non-thyronine I secretion. Neither effect was mediated by TSH. (BBB)

34051 DIFFERENCES IN THE ^{51}Cr LABELING PATTERNS OF COD (GADUS CALLARIAS) AND HUMAN BLOOD. Murray, J.; Burt, J. R. (Torry Research Station, Aberdeen, Scotland). Comp. Biochem. Physiol.; 31: 167-73(Oct 1969).

The site of attachment of radiochromium to cod blood cells and human blood cells was investigated. The uptake of ^{51}Cr was 58 and 50% for the human blood labeled at 0.014 and 0.36 μg Cr/ml blood respectively. In general, cod blood took up a slightly greater proportion of the added ^{51}Cr, comparable figures being 73 and 68% at 0.017 and 0.17 μg/ml respectively. The separations obtained with cod blood hemolysates on Sephadex G75 and G100 showed that an initial peak of activity contained only a trace of heme pigment as opposed to the highly colored fractions immediately following. Hemolysates of labeled cod blood cells showed that only 27% of the activity is recovered in the hemoglobin fraction, the comparable figure for human blood cells being 85%. In cod blood the activity not attached to the hemoglobin fraction is not associated with a single compound. (BBB)

34052 SUPPRESSION OF VICTORIN TOXICITY IN OATS BY URANYL SALTS. Hanchey, Penelope (Univ. of Kentucky, Lexington). Phytopathology; 59: 1960-2(Dec 1969).

Electrolyte leakage from first leaves of victorin-treated susceptible oats is suppressed by simultaneous treatment with uranyl salts. On the basis of ferrocyanide colorimetric assays, complex formation between victorin and uranium has been reported. A binding of uranyl ions in culture filtrates that contain victorin was confirmed by spectrophotofluorometric assays. Similar binding occurred in solutions of deactivated victorin. Uranyl salts

suppressed victorin-induced electrolyte leakage when applied as a pretreatment, but post-treatments were ineffective. No reversal of victorin-induced root growth inhibition with uranyl salts was observed. Whether these results reflect an effect of UO_2^{++} on cell membranes or complex formation between uranium and victorin remains undetermined. (auth)

34053 THYROIDAL UPTAKE OF RADIOACTIVE IODINE (^{131}I) IN CHICKENS. Shibata, Hiroshi; Ikeda, Miyoshi (Tokyo Univ.). Nippon Juigaku Zasshi; 31: 277-84(Dec 1969). (In Japanese).

This study was undertaken to clarify the thyroidal uptake of radioactive iodine (^{131}I) in chickens. The results obtained are summarized as follows. $Na^{131}I$ (20 μCi/kg) was administered orally to chickens. Ingested $Na^{131}I$ was rapidly absorbed through the gastrointestinal tract, primarily through the small intestine, into the blood stream. The ^{131}I concentration in the blood reached a maximum 2 hours after dosing. Thereafter, it decreased almost exponentially. No radioactivity of ^{131}I in the blood could be detected on the 20th day after dosing. The ^{131}I in the blood was primarily taken up by the thyroid glands. The ^{131}I concentration in the thyroid glands reached a maximum 24 hours after dosing, and the maximum value was equivalent to about 15% of the administered dose. Thereafter, the ^{131}I concentration decreased almost exponentially. The radioactivity of ^{131}I in the thyroid glands could be detected even on the 60th day after dosing. When oral administration of $Na^{131}I$ and intraperitoneal injection of an antithyroid substance, such as KI (10 mg/kg), $KClO_4$ (30 mg/kg), KSCN (50 mg/kg), and methylthiouracil (MTU, 50 mg/kg) were done simultaneously, there was a decrease in thyroidal uptake of ^{131}I. KI and $KClO_4$ were the most potent. When a single intraperitoneal dose of an antithyroid substance was injected 24 hours before dosing with $Na^{131}I$, thyroidal uptake of ^{131}I was decreased by KI, but was unaffected by $KClO_4$, KSCN, or MTU. When an intraperitoneal dose of KI (10 mg/kg) was injected daily for 5 days before dosing with $Na^{131}I$, thyroidal uptake of ^{131}I was significantly decreased. When a single intraperitoneal dose of KI, $KClO_4$, KSCN of MTU was injected 24 hours after dosing with $Na^{131}I$, the ^{131}I in the thyroid glands was not effected. On the other hand, when KI (10 mg/kg) was injected intraperitoneally 5 times at intervals of 5 hours, beginning at 24 hours after dosing with $Na^{131}I$, the ^{131}I was rapidly eliminated from the thyroid glands. The thyroidal uptake of ^{131}I of a chicken fed a low iodine diet (iodine contents: 0.04 ppm) was significantly greater than that of a chicken fed a normal diet (iodine contents: 0.65 ppm). The thyroidal uptake of ^{131}I seemed to be affected by the iodine content of the diet. (auth) (NSA of Japan)

34054 ULTRA STRUCTURAL LOCALISATION OF INHALED $^{239}PuO_2$ PARTICLES IN ALVEOLAR EPITHELIUM AND MACROPHAGES. Sanders, C. L.; Adee, R. R. (Battelle Memorial Inst., Richland, Wash.). Health Phys.; 18: 293-5(Mar 1970).

It is important to know the microscopic distribution of inhaled radioactive particles in the lung, since localization in the various cell types will influence patterns of particle movement and pulmonary clearance and the resultant distribution of radiation dose. Most inhaled PuO_2 particles deposited in the alveoli are phagocytized by pulmonary macrophages within a few hours, but not all the particles are found in macrophages. Autoradiographic studies indicated that inhaled non-phagocytized PuO_2 particles will also penetrate into the alveolar wall. Evidence for a physiological role for the alveolar epithelium in lung clearance is discussed. Some distribution studies with albino rats are described, employing an aerosol of PuO_2 particles, and the results are discussed. Among conclusions reached are that the accumulation of PuO_2 particles in the alveolar wall may explain why the inhaled material shows such a long residence time in the deep lung; such sequestered particles may not be readily cleared from the respiratory system. (UK)

34055 ISOTOPE CONTENT OF OLIGONUCLEOTIDES OF NUCLEAR AND NUCLEOLAR RNA OF RAT LIVER. Marks, Friedrich; Hidvegi, Egon J.; Yazdi, Ebrahim; Busch, Harris (Baylor Coll., Houston, Tex.). Biochim. Biophys. Acta; 195: 340-50(1969).

Nuclear and nucleolar RNA of rat liver labeled with [6-^{14}C] orotic acid or [^{32}P]orthophosphate were separated into sedimentation classes of 18-S, 28-S, 35-S, 45-S, and 55-S nuclear RNA and 28-S, 35-S, and 45-S nucleolar RNA. After purification of each class of RNA, the distribution of radioactivity was determined in the oligonucleotides obtained by hydrolysis with pancreatic ribonuclease after they were separated by a mapping technique. For nucleolar 28-S, 35-S, and 45-S RNA, no marked differences were found for distribution of either isotope in the oligonucleotides. The distributions of isotope in oligonucleotides of nuclear 28-S and 35-S RNA were very similar; these oligonucleotide distributions differed from those of the 18-S and 55-S nuclear RNA which were also very similar. On the basis of the distribution of isotope in the oligonucleotides, liver nuclear 28-S, 35-S, and 45-S RNA appear to be mixtures of the nucleolar, GC-rich RNA and the cosedimenting AU-rich RNA. The data are interpreted by the hypothesis that 28-S, 35-S and 45-S nucleolar ribosomal precursor RNA have very similar primary structures. Since 18-S nuclear RNA has a very similar distribution of isotope in oligonucleotides to that of 55-S nuclear RNA, the latter may be a precursor of nuclear 18-S RNA. (auth)

34056 CLEARANCE MECHANISM OF THE RES FOLLOWING APPLICATION OF HIGH DOSES OF ^{198}Au WITH RESPECT TO DISTRIBUTION KINETIC AS WELL AS ADAPTATION CAPABILITIES. Nuic, Marina; Leonhardt, Lutz (Medizinische Hochschule, Hanover). Strahlentherapie; 139: 221-7(Feb 1970). (In German).

The parenchymal reactions in the liver were followed in animals after administration of high doses of ^{198}Au colloids. At the same time the modifications of the clearance mechanisms of the RES were followed as was its repartition between liver and spleen. Depending on the inhibition of clearance in the liver, an increase of spleen activity is noted. These results could be confirmed in rabbits after one administration of PVNO, an RES blocking drug. The adaptative mechanisms of the RES and the possibility of its effect on the higher spleen uptake are outlined. (auth)

34057 ROLE OF PITUITARY ACTH IN THE REGULATION OF RADIOCALCIUM AND RADIOPHOSPHORUS UTILIZATION IN THE INDIAN CATFISH, HETEROPNEUSTES FOSSILIS BLOCH. Srivastava, Pratap N.; Devi, P. Uma (Univ. of Rajasthan, Jaipur, India). Strahlentherapie; 139: 236-42(Feb 1970).

Indian catfish, Heteropneustes fossilis Bloch, were injected intramuscularly with 3 I.U. of porcine ACTH per fish and the effect on ^{32}P and ^{45}Ca uptake by several tissues was studied. ACTH reduced ^{32}P uptake in kidneys, brain, and bones, while liver and muscle did not show any change in uptake. The increase in uptake exhibited by the heart was not appreciable. There was a latent period of four to eight hours before any effect was manifested. All tissues showed a trend to return to the control level by the fifth day. The accumulation of ^{45}Ca was not affected by the hormone treatment in heart, brain, bone, and muscle but a slight increase in activity was observed in liver and kidneys in the experimental group. It was assumed that hypophosphatemia was caused by ACTH and that this was reflected in the reduced uptake of radiophosphorus by the tissues. This effect is not manifested immediately after the hormone administration but shows a latent period in early intervals after the injection. (auth)

34058 THE PHARMACOLOGIC EFFECT OF DEUTERIUM SUBSTITUTION ON 5-n-BUTYL-5-ETHYLBARBITURIC ACID. Tanabe, Masato; Yasuda, Dennis; LeValley, Susanna; Mitoma, Chozo (Stanford Research Inst., Menlo Park, Calif.). Life Sci.; 8: 1123-8(1 Oct 1969).

Various drugs are oxidized and inactivated by the liver microsomal system at a specific C-H bond. If breaking of this bond is rate-limiting in the oxidative process, substitution of the hydrogen atom(s) by deuterium atom(s) at the site of oxidation should substantially decrease the rate of oxidation. Such substitution should increase biological half-life and prolong the pharmacologic action of the deuterated drug. The sleeping time of mice given butethal deuterated at the penultimate carbon atom was compared with that of mice given unlabeled butethal. An in vivo isotope effect was observed, with more than a 2-fold increase in the sleeping time induced by 3'-deuteriobutethal. 4'-Deuteriobutethal gave equivocal data but generally showed a prolongation of the sleep time, indicating that the terminal carbon might also be involved in the metabolism of butethal. To investigate the biochemical basis for the prolongation of the sleeping time by 3'-deuteriobutethal, the biological half-lives and the rates of hydroxylation of butethal and 3'-deuteriobutethal were compared. It was shown that the half-life of the latter was ~2½ times longer than that of the former. In vitro the rate of hydroxylation of the deuterium-labeled butethal was lower than that of the nondeuterated butethal. A kinetic isotope effect of 1.6 was observed. The metabolite of butethal was identified as 5-ethyl-5-(3'-hydroxybutyl)barbituric acid by comparison with the authentic sample of the metabolite on silica gel G thin-layer plates. It is concluded that the substitution of the hydrogen atoms at the 3'-position of butethal with deuterium atoms results in prolongation of the sleeping time of mice. (BBB)

34059 STUDIES ON INHIBITION OF INTESTINAL ABSORPTION OF RADIOACTIVE STRONTIUM. VII. RELATIONSHIP OF BIOLOGICAL ACTIVITY TO CHEMICAL COMPOSITION OF ALGINATES OBTAINED FROM NORTH AMERICAN SEAWEEDS. Tanaka, Y.; Waldron-Edward, D.; Skoryna, S. C. (McGill Univ., Montreal). Can. Med. Ass. J.; 99: 169-75(27 Jul 1968).

The results of studies on a number of species of brown sea-

weeds collected on the Atlantic and Pacific coasts of Canada and the United States are reported. The crude yield, moisture, and alginic acid content as well as mannuronic-guluronic acid ratio were estimated in 19 different samples of Phaeophyceae. Biological activity, i.e., inhibition of strontium absorption, was measured in the rat by the intubation method described previously. Alginates with high guluronic acid content were found in general to be more effective, although several other factors are involved. The active alginates also enhance the rat's normal physiological discrimination, with the result that there is little interference with calcium absorption. Some samples appeared to have no effect on calcium absorption. The crude yield of alginates which can be obtained from the various species of seaweeds, and also the extent to which the isolated alginate is free from inert contaminants, vary considerably. At present the environmental conditions accompanying the collection, such as tidal flow and seasonal and temperature changes, are being studied, as these may also be of significance. (auth) (Canada)

34060 ELECTRON MICROSCOPE STUDY OF INGESTION OF THOROTRAST BY AMOEBOCYTES OF PINCTADA RADIATA. Nakahara, H.; Bevelander, G. (Univ. of Texas, Houston). Tex. Rep. Biol. Med.; 27: 101-9(1969).

An electron microscopic study of the ingestion of particulate matter by molluscan amebocytes was carried out, colloidal thorium (thorotrast) being injected into the adductor muscle. At intervals from 1 hr to 19 days, portions of the mantle containing amebocytes were removed for examination. The thorotrast particles when exposed to the hemolymph acquire a fibrin like envelope. When contact with the membranous part of the pseudopod occurs, the particles are enveloped by folds which then become minute channels. These channels are withdrawn into the cytoplasm of the cell and the terminal portions are pinched off giving rise to minute pinocytic vesicles. The vesicles, some containing thorotrast particles, then migrate deep into the cytoplasm, where they fuse with dense bodies (lysosomes). After 24 hr virtually all the injected material is in these organelles. Specimens allowed to remain in the tanks for 19 days following injection of the particulate material still exhibit thorotrast in the dense bodies. (Excerpta Med.)

34061 A COMPARATIVE STUDY OF ^{42}K AND ^{24}Na MOVEMENTS DURING THE CARDIAC CYCLE. Coraboeuf, E. (Faculte Des Science, Orsay France); Delahayes, J.; Sjoestrand, U. Acta Physiol. Scand.; 76: 40-8(1969).

Studies of potassium-42 and sodium-24 movements during the cardiac cycle were made on the right ventricle from the rat and guinea pig, on frog atrium and on frog ventricular strips. The potassium-42 study showed a cyclic leakage of radioactive potassium from the rat ventricle. No such leakage was observed during the electrical activity. The sodium-24 study showed a slight decrease in the radioactive sodium efflux from the rat and guinea pig ventricle at the depolarization phase and the first by a slight decrease was observed. The possibility of mechanical artifacts is discussed and an interpretation of the results is proposed that is based on a different pattern of potassium permeability between the species, the guinea pig and frog showing a rectangular action potential and the rat a sigmoid action potential. The slight decrease in sodium-24 activity preceding the mechanical systole could reflect the basic ionic mechanisms of the depolarization. (auth) (Sweden)

34062 INTERACTIONS OF ^{233}Pa WITH TISSUES OF MYTILUS GALLOPROVINCIALIS AND CARCINUS MEDITERRANEUS. Lucu, C. (Inst. Ruder Boskovic, Zagreb); Jelisavcic, O.; Lulic, S.; Strohal, P. Mar. Biol.; 2: 103-4(Feb 1969).

Uptake of ^{233}Pa from sea water by mussels, Mytilus galloprovincialis L. and shore crabs, Carcinus mediterraneus Csrn. was studied. Results indicate a high contamination factor in digestive tract, gills and skeleton of both investigated species and an increment of the contamination factor in mussel byssus. In spite of this, reproductive system, muscle and hemolymph were only negligibly contaminated. The presence of EDTA in sea water has no effect on uptake of ^{233}Pa in the animal tissues tested. (auth)

34063 RADIOCALCIUM UPTAKE IN THE BONES OF THE FOOT. Anderson, J. (King's Coll. Hospital, London); Tomlinson, R. W. S.; Ramsay, I. D.; Clarke, M. B.; Osborn, S. B. Brit. J. Radiol.; 43: 168-72(Mar 1970).

A technique is described for the measurement of the radiocalcium content of the bones in the foot. The results indicate a calcium turnover rate for both feet averaging 70 mg h^{-1} in control subjects and 158 mg h^{-1} in hyperparathyroid patients. The foot radioactivity reaches a maximum in between 20 and 50 hours, after which it declines. (auth) (UK)

34064 MEASUREMENT OF ^{212}Pb LOSS RATE FROM HUMAN LUNGS. Hursh, J. B.; Mercer, T. T. (Univ. of Rochester, N. Y.). J. Appl. Physiol.; 28: 268-74(Mar 1970).

Experiments were performed in which four human subjects were administered ^{212}Pb by mouth inhalation and by intravenous injection. Blood, urine, and fecal samples were collected. ^{212}Pb inhaled on natural aerosols showed lung depositions of 27 to 62%, the amount depending on well-characterized aerosol size differences. The loss rate from the lung measured by in vivo gamma counting as corrected for extralung activity in the lung survey field had a half-time of from 10.5 to 11.5 hr. Twenty-four hour urinary lead excretion after intravenous injection was from 2.6 to 6.6% dose. Fecal collections (34 to 48 hr) yielded 0.2 to 2.7% dose. (auth)

34065 EFFECT OF ANTI-INFLAMMATORY DRUG THERAPY ON CLEARANCE OF ^{133}Xe FROM KNEE JOINTS OF PATIENTS WITH RHEUMATOID ARTHRITIS. Brit. Med. J.; 3: 278-80 (2 Aug 1969).

The clearance of ^{133}Xe as a measure of the anti-inflammatory effect of Na salicylate and indomethacin was assessed. Since ^{133}Xe has a high blood/air partition coefficient, over 90% of the circulating radioisotope is cleared from the body by the lungs in one passage. The mean values for the half-life of the ^{133}Xe clearance; the knee score; and the articular index while the patients received placebo, sodium salicylate, and indomethacin were measured and compared. The clinical degree of joint inflammation in 13 patients with rheumatoid arthritis was reduced by both Na salicylate and indomethacin alone, and showed no correlation with the other clinical features. (BBB)

34066 TOXICOLOGIC EVALUATION OF RADIO-PHARMACEUTICALS. Miller, Jonathan P.; Crawford, L. E. Michael (Abbott Labs., Chicago). Kaku Igaku; 6: 213-16(Sep 1969).

Typical administered doses of various radiopharmaceuticals are summarized and tabulated. A table, based on typical doses to man and acute intravenous toxicity studies in mice, is presented to show acute toxicity safety factors for ^{131}Cs-labeled cesium chloride, ^{203}Hg-labeled chlormerodrin, ^{99m}Tc-labeled sodium pertechnetate, ^{131}I-labeled sodium iothalamate, ^{198}Au-labeled colloidal gold, ^{99m}Tc-labeled technetium sulfide, and ^{131}I-labeled albumin. Studies on estimation of maximum amounts of ^{99}Tc that might be injected during a brain scanning dose of ^{99m}Tc-labeled sodium pertechnetate are discussed. In the evaluation of ^{203}Hg-labeled chlormerodrin it was shown that specific activity and administered dose can have significant effects on distribution and excretion. (H.L.W.)

34067 AFFINITY OF ^{67}Ga FOR MALIGNANT TUMOR. Ando, Atsushi; Hisada, Kin-ichi (Kanazawa Univ., Japan). Radioisotopes (Tokyo); 19: 239-46(May 1970). (In Japanese).

The mechanism of the accumulation of ^{67}Ga in tumors was investigated. Five chemical forms of ^{67}Ga-citrate (carrier-free), ^{67}Ga-citrate (containing carrier Ga-citrate), ^{67}Ga-nitrate (carrier-free), ^{67}Ga-nitrate (containing carrier Ga-nitrate) and ^{67}Ga-EDTA (carrier-free) were prepared. Their affinities for the malignant tumor were examined. These five preparations were injected intravenously into rats with subcutaneously transplanted Yoshida Sarcoma and these rats were sacrificed 3 hr, 24 hr and 48 hr after the injection. The radioactivities of the tumor, blood, muscle, liver, kidney and spleen were measured by a well-type scintillation counter. The retention values (% dose per g tissue weight) in the tumor, blood, muscle, liver, kidney and spleen were calculated. ^{67}Ga-citrate (carrier-free) and ^{67}Ga-nitrate (carrier-free) have very close affinities for the malignant tumor and their retention values in the tumor were approximately constant during 48 hr. Their excretion into urine was slower than the other three preparations. The affinities of ^{67}Ga-citrate (containing carrier Ga-citrate) and ^{67}Ga-nitrate (containing carrier Ga-nitrate) for the tumor were weak and the excretion into urine was faster than for the carrier-free compounds. ^{67}Ga-EDTA was rapidly excreted into urine and its affinity for the tumor was weak. Also, the experiment with rats that had intraperitoneally transplanted Yoshida Sarcoma showed that ^{67}Ga-citrate (carrier-free) and ^{67}Ga-nitrate (carrier-free) were taken up considerably by Yoshida Sarcoma ascites cells. From these experimental results, it may be deduced that a suitable chemical form of ^{67}Ga has a strong affinity for tumors. ^{67}Ga-nitrate becomes gallium-ion in water, and it is known that ^{67}Ga-citrate becomes gallium-ion when it is diluted with an adequate amount of water. Therefore the chemical form suitable for the selective uptake by tumor cells should be carrier-free and able to become gallium-ions easily in the body. Chemical properties of gallium were also studied. The binding capacity of gallium-ion to protein is not strong, but its binding capacity to glass is very strong. It is likely that the gallium-ion is either physiologically necessary for cancerous cells, or, if not, it has a specifically strong affinity for tumors for unknown reasons. (auth)

34068 EFFECT OF ALGINATE ON THE ABSORPTION OF LEAD IN MAN. Harrison, G. E. (Medical Research Council,

Harwell, Eng.); Carr, T. E. F.; Sutton, A.; Humphreys, E. R.; Rundo, J. Nature (London); 224: 1115-16(13 Dec 1969).

The expected stability constants of metal alginates suggested that supplementing diet with guluronic acid-rich alginate derivatives might suppress the absorption of certain heavy metals, many of which are toxic. If absorption of lead could be reduced by alginate supplementation this would be of considerable interest, since lead accumulates slowly in body tissues and appreciable body burdens may be acquired by children. Some preliminary experiments on rats indicated that a small decrease in lead absorption was produced when they were fed a milk diet supplemented with alginate. In experiments with humans some volunteers took 5 μCi of ^{203}Pb, twice at 10 day intervals. On the first occasion 5g of a purified guluronic rich alginate derivative was also taken in water, and some hours later blood samples were taken and analyzed for ^{203}Pb. Urine and feces analyses were also made. The absorption of the lead was expressed as the bulbed 5 day urinary excretion of ^{203}Pb plus the observed body retention 5 days after dosing, the latter being measured directly by an external ^{203}Pb γ count; body retention was also derived from the oral dose minus the excretion. All results are shown in tabular form. It was found that lead absorption was markedly different in different subjects. The conclusion from this limited trial is that lead absorption is unchanged in adults by alginate supplementation of diet. (UK)

34069 USE OF A MINIATURE GM COUNTER AND A WHOLE BODY COUNTER IN THE STUDY OF POTASSIUM TRANSPORT BY THE COLON OF NORMAL, SODIUM-DEPLETED, AND ADRENALECTOMIZED RATS IN VIVO. Barnaby, C. F.; Edmonds, C. J. (University Coll. Hospital Medical School, London). J. Physiol. (London); 205: 647-65(1969).

A method is described employing a whole-body counter and a miniature GM counter placed within the lumen of the gut which can be used to study the absorption rates and kinetics of labeled substances in the mucosal epithelium in vivo. The method was applied to the study of K transport by mucosa of the descending colon of normal, Na-depleted and adrenalectomized rats. The K influx rate was linearly related to luminal [K] over the range 5 to 80 mM. NaCN in the lumen produced a fall of electrical potential difference (p.d.) and of K secretion rate but did not reduce K influx rate. The findings were consistent with passive K influx. The mucosal ^{42}K content reached a steady value after 60 to 90 min of exposure to ^{42}K in the lumen. The value was similar in normal and adrenalectomized rats but was greater in Na-depleted rats. After replacement of luminal solution by a non-radioactive solution the fall of mucosal ^{42}K content could be described by a curve having two exponential components with half-times of 8 to 10 and 65 to 106 min. Approximately half of the ^{42}K outflow passed to the lumen. The rate constants were similar in all groups of rats. The results analyzed on the basis of representing the mucosal K as in two compartments, indicated that the observed absorption rate could not be accounted for by transport through these compartments alone and that most of the ^{42}K crossed the mucosa by a fast pathway not detectable by the miniature GM counter. Most of the mucosal K was relatively inaccessible from the lumen. Na depletion raised the transmucosal p.d., increased the K secretion rate and appeared to increase K permeability of the mucosa but the kinetics were unaltered. Accumulation of ^{42}K in the mucosa was greater, suggesting that the permeability of the luminal face had increased. Adrenalectomy produced only one change, namely a reduction of K secretion rate. (auth) (UK)

34070 THE DISAPPEARANCE OF ^{133}Xe AND ^{125}I FROM SKELETAL MUSCLE OF THE ANESTHETIZED DOG DURING SYMPATHETIC CHOLINERGIC VASODILATION. Bolme, Per; Edwall, Lennart (Karolinska Inst., Stockholm). Acta Physiol. Scand.; 78: 28-38(Jan 1970).

The disappearance rate of ^{125}I and ^{133}Xe from a depot in the gastrocnemius muscle of the dog was determined during vasodilatation caused by activation of the sympathetic cholinergic vasodilator nerves. During vasodilatation the disappearance rate of ^{125}I and ^{133}Xe increased. No systematic difference in the disappearance rate was observed between the water-soluble (^{125}I) and the fat-soluble (^{133}Xe) tracer. The vasodilatation did not usually last for more than 30 sec. and during this period the increase in disappearance rate often exceeded the increase in blood flow. The disappearance rate of ^{133}Xe from different muscles was studied during stimulation of hypothalamic vasodilator pathways and was found to be enhanced from the splenius, latissimus dorsi and gastrocnemius muscles but not from the masseter muscle. Vasodilator nerve stimulation and acetylcholine infusion caused comparable increases in disappearance rate during the blood flow increase. When the blood flow was back to resting levels, a decrease in disappearance rate below control values was seen. The increase in disappearance rate during sympathetic nervous vasodilatation was usually less than during metabolic vasodilatation and after metabolic vasodilatation no decrease was observed in the disappearance rate. The results support the hypothesis that during metabolic vasodilatation precapillary sphincters are opened up leading to an increased capillary surface area while the vasodilator nerves do not directly influence the exchange surface area. (auth) (Sweden)

34071 FIRST EXPERIMENTAL DATA ON ^{137}Cs DYNAMICS IN ANGUILLA ANGUILLA (L). Reynier, Bernard; Foulquier, Luc; Angelier, Eugene; Grauby, Andre (CEA, Cadarache, France). Compt. Rend., Ser. D; 270: 862-5(9 Feb 1970). (In French).

Yellow eels were kept for 100 days in fresh water labeled with ^{137}Cs. The skin, spleen and digestive tube, and also the heart, liver, kidneys and gills, show an activity peak between the 8th and 11th day. A decontamination phenomenon is then observed for all these organs. On the other hand the specific activity of the muscular mass increases progressively and reaches a state of equilibrium towards the 27th day. At this stage about 80% of the radiocesium is fixed in the muscles where it is strongly retained. (France)

34072 INTERACTIONS OF THYROXINE AND THYROCALCITONIN IN THE RAT. Cherny, Samuel N.; Chausmer, Arthur B.; Bellavia, Josephine V.; Wallach, Stanley (State Univ. of New York, Brooklyn). Endocrinology; 86: 1337-46(Jun 1970).

Studies of the level of plasma calcium, the hypocalcemic and bone resorptive responses to exogenous thyrocalcitonin (TCT), and the uptake of ^{47}Ca and ^{85}Sr by the skeleton and soft tissues were performed in intact and thyroparathyroidectomized rats following a single dose of 250 μg of l-thyroxine (acute T_4) and after 9 to 21 days of administration of 125 μg of l-thyroxine three times a week (chronic T_4). In acute T_4 treated rats, the hypocalcemic effect of exogenous TCT was augmented, whereas, with chronic T_4 treatment, a reduced effect of exogenous TCT was observed. The excretion of ^{85}Sr derived from the prelabeled skeleton was reduced with both acute and chronic T_4 treatment, and exogenous TCT was normally effective in further reducing the excretion of ^{85}Sr. Chronic treatment with T_4 caused mild hypocalcemia, and significantly increased skeletal and soft tissue uptakes of ^{47}Ca and ^{85}Sr. These results in young rats are dissimilar to previous studies in humans and dogs in which the predominant effect of T_4 is an enhancement of bone resorption, with resultant hypercalcemia, hypercalciuria, and demineralization. The data indicate that, in the growing rat, large doses of T_4 have a significant anabolic effect on the calcium metabolism of the skeleton and may promote calcium uptake by certain soft tissues as well. (auth)

Radiation Effects

Refer also to abstracts 33726, 34238, 34404, 34411, 34574, 34578, 34582, 34591, 34608, 34630, 34656, 34685, 34689, 34691, 34694, 34741, 34785, 34799, 34800, and 34833.

34073 (AD-690855) PHYSICOCHEMICAL TISSUE CHANGES FOLLOWING IRRADIATION. Final Report, July 1958-June 1969. Reynolds, B. L. (Consultants International, Inc., Dallas, Tex.). Aug 1969. Contract DA-49-193-MD-2368. 16p. (CII-R-69106). CFSTI.

Whole body irradiation (WB1) produces scopal and abscopal effects in albino rats. Primary scopal events are deploymerization of interstitial substance (ISW) mucoprotein, with increases in acid, free water and destruction of mobile cells of ISW (erythrocytes; leukocytes; histiocytes; plasma cells). Membranes resistant to water perfusion form in ISW, and may proceed to frank fibrosis, depending upon quality and quantity of WB1. Abscopal effects follow dissemination of scopal physicochemical agents, and affect, particularly, brain, heart, lung, kidney, and gastrointestinal tract. Iatrogenic alteration of the ISW is possible for reduction of scopal effects of WB1, hence abscopal perfusion. (auth)

34074 (AD-700724) DETECTION OF BIOLOGIC CHANGES IN ANIMALS EXPOSED TO LOW LEVELS OF IONIZING RADIATION. Final Report, January-December 1968. Maciasr, Frank M.; Beattie, Jack M. (Northrop Corporate Labs., Hawthorne, Calif.). Nov 1969. Contract F41609-68-C-0014. 23p. (NCL-69-5-R; SAM-TR-69-41). CFSTI.

Urinary excretion of fluorescent products was investigated in Macaca mulatta exposed to whole-body, single dose cobalt-60 gamma irradiation of 28, 53, and 106 rads. Ion-exchange and gel-filtration chromatography was used to fractionate and quantitate radiation-responsive urinary products. Radiation dose response relationships were measurable in one major fluorescent fraction within 72 hours postirradiation at all dose levels. A radiation

response relationship was measurable within 6 hours at the 106-rad level. The radiation responsive fluorescent subfraction appears to be predominantly composed of large molecular weight (700 to 1,500) acidic heterocyclic amines. The major source of deviation from linearity of response to dose arose from the large variation in the volume of urine excreted by the monkeys. Much greater and earlier correlation between the low irradiation doses and the level of excretory products could probably be obtained by controlling the water intake of the animals. (auth) (USGRDR)

34075 (AD-701755) CORRELATION OF RADIATION-INDUCED ULTRASTRUCTURAL CHANGES IN MOUSE HEPATOCYTES WITH ALTERATIONS IN PLASMA CONCENTRATION OF PROTEIN-BOUND NEUTRAL HEXOSES. Rene, A. A.; Evans, A. S. (Armed Forces Radiobiology Research Inst., Bethesda, Md.). Dec 1969. 21p. (AFRRI-SR-69-25). CFSTI.

C3H mice were subjected to a whole-body dose of 530 rads of mixed gamma-neutron radiation delivered at a rate of approximately 20 rads/min. The blood plasma concentration of protein-bound carbohydrates, as neutral hexoses, was estimated daily after irradiation. Ultrastructural architecture of liver tissue taken from irradiated animals in extremis was compared with that of survivors and fed and starved unirradiated controls. Among the radiation-induced differences observed in the hepatocytes were moderate to marked dilatation of the rough endoplasmic reticulum, increased Golgi activity, and rounding of the mitochondria with a decrease in numbers of mitochondrial granules. These alterations, together with other differences noted, were correlated with the increased plasma concentration of protein-bound neutral hexoses uniformly found in animals which succumb to radiation injury. (auth)

34076 (AD-701756) RADIATION-INDUCED ULTRASTRUCTURAL CHANGES IN LYSOSOMES. I. CYTOCHEMICAL ANALYSIS. Rene, A. A.; Parker, J. L.; Darden, J. H. (Armed Forces Radiobiology Research Inst., Bethesda, Md.). Dec 1969. 27p. (AFRRI-SR-69-26). CFSTI.

Ultrastructural and biochemical changes in lysosomes of rat liver following exposure to ionizing radiation were studied. A marker for acid phosphatase was used to visually correlate the progressive changes in lysosomes with the cellular necrobiotic process postirradiation. The earliest observable change in the lysosomes and/or lysosomal enzymes corresponding with the sequence of fine structural alterations following irradiation suggests that radiation labilizes the lysosomal membrane resulting in a release of enzymes responsible for cell damage. The concentration of the lead phosphate reaction product indicated that the initial action on the lysosome is evidently a "build-up" of hydrolytic enzymes within two hours after irradiation followed by a gradual release of the marked enzyme 2-24 hours postirradiation as noted by decreased enzyme concentration within the lysosomes. The release of the enzyme appeared to be directly related to an increasing cellular necrobiosis following irradiation. (auth)

34077 (NYO-2804-27) BASIC ASPECTS OF ACTION OF RADIATION ON MICROORGANISMS. Progress Report, September 1, 1969-August 31, 1970. Pollard, Ernest C. (Pennsylvania State Univ., University Park. Dept. of Biophysics). May 1970. Contract AT(30-1)-2804. 16p. Dep. CFSTI.

Effects of radiation on DNA degradation in Escherichia coli cells were studied. It was shown by radioautography that there was no DNA in some cells while others retained DNA; this is designated the all-or-nothing effect. Studies were also conducted on the growth of bacteriophage T4 in irradiated cells. It was noted that radiation caused changes in the character of DNA which in turn caused the DNA to become degraded very rapidly; the role of an enzyme system, nucleolysin, in this phenomenon is discussed. Protective effects of RNA polymerase were studied by treating cells with rifampicin. Nitrosoguanidine and radiation were used in attempts to find a mutant lacking the enzyme responsible for DNA degradation. A correlation between the content of prophage in the cell and resistance to degradation was observed. Experiments were conducted on reassociation of DNA from strain 15 cells that are capable of full degradation and that contain an episome which is almost certainly a defective prophage. Effects of the oxygen/nitrogen ratio on DNA degradation and synthesis and on colony-forming ability of cells of strain B_{s-1} were investigated. Other studies were conducted on the effects of ionizing radiation on the developing spore system of Bacillus subtilis. (H.L.W.)

34078 (UR-49-1290) STUDIES ON THE BIOSYNTHESIS OF HEPATIC GLYCOGEN AND LIPIDS IN THE IRRADIATED RAT. Sobocinski, Philip Zygmund (Rochester Univ., N. Y. Dept. of Radiation Biology and Biophysics). 1970. 97p. Dep. CFSTI. Thesis.

Tissue proteins were labeled prior to irradiation by injecting young adult rats with alanine-UL-^{14}C. All rats were starved 24 hours prior to irradiation (750R, total-body exposure, 250 kV x-ray source) and throughout the entire postirradiation period (up to 72 hours). At 24 hours postirradiation a three-fold increase, in terms of percent of administered ^{14}C dose, is incorporated into glycogen and concurrently the concentration of glycogen rises to a similar extent. At the same time, the plasma glucose concentration rises in a parallel fashion. Glycogen accumulation is transient in livers of x-irradiated rats and declines to control levels 72 hours after irradiation, similarly, plasma glucose concentration declines in a parallel fashion. The specific ^{14}C-activity of plasma and glycogen glucose during the 48 hours after irradiation is the same in sham- and x-irradiated rats, however, 72 hours after irradiation the specific ^{14}C-activity of plasma and glycogen glucose is higher in x-irradiated than in sham-irradiated rats. In order to inhibit gluconeogenesis at the level of phosphoenolpyruvate carboxykinase, L-tryptophan and quinolinate were administered to rats before and after irradiation under otherwise the same experimental conditions as described above. In order to inhibit gluconeogenesis at the level of pyruvate carboxylase, quinaldate was administered in a similar fashion. Tryptophan and quinaldate-treated rats showed a marked depression of glycogen concentration and ^{14}C-activity 24 hours after x-irradiation (approximately 77 and 99 percent of controls, respectively). The rise of concentration and ^{14}C-activity of glucose of glycogen constitutes evidence of radiation-induced increased gluconeogenesis and glycogenesis from labeled tissue proteins. The results obtained with L-tryptophan and quinaldate strongly support the initial premise that amino acids derived from radiation-induced, excessive protein catabolism constitute a major source of carbon atoms for glycogen synthesis in livers and glucose in the plasma of starved, x-irradiated rats since the concentration and ^{14}C-activity of glycogen in these livers was markedly reduced in the presence of tryptophan and quinaldate. The total lipid content and the total amount of ^{14}C incorporated into total lipids were similar in livers of sham- and x-irradiated rats during the 72 hours postirradiation, however, changes in total amount and specific activity of individual lipid fractions were observed. The total content and ^{14}C-activity of cholesterol esters were markedly decreased in livers of x-irradiated rats, 24 and 48 hours after irradiation. Changes noted in other lipid fractions in livers of x-irradiated rats indicate that alterations may occur in the precursor pools, rate of synthesis, and release of lipids from the liver during the 72 hours postirradiation. (auth)

34079 FLUORESCENT-CYTOCHEMICAL DETECTION OF DNA INJURY IN IRRADIATED LYMPHOCYTES. Meisel, M. N.; Manteifel, V. M.; Dolgorukova, N. I. (Inst. of Molecular Biology, Moscow). Izv. Akad. Nauk SSSR, Ser. Biol.; No. 5, 767-70(Sep-Oct 1969). (In Russian).

DNA changes in the nuclei of lymphocytes from lymph nodes of whole-body irradiated white rats were detected by the fluorescence-cytochemical method described by Roschau based on mild hydrolysis with N HCl and successive fluorochroming with acridine orange and used for the determination of injured DNA in necrotic tumor cells. It was shown that the nuclei of irradiated lymphocytes fluorochromed with acridine orange following mild hydrolysis with HCl displayed a series of consecutive disturbances followed by color changes of the acridine orange DNA complex and evidently correspond to different deoxiribonucleoproteids and deoxiribonucleic acid molecular disturbances. It was also found that a shift towards the red spectral region is observed in the majority of pyknotic nuclei; such nuclei display a bright red luminescence. A similar reaction of the nuclei was also found in the course of in vivo irradiation both of the lymphocytes and the cells of human amnion epithelium. (auth)

34080 KINETICS OF PROTEASE INACTIVATION BY γ IRRADIATION. Kubota, Minoru; Ohnuma, Akihiko (Tokyo Univ. of Fisheries). J. Tokyo Univ. Fish.; 55: 9-20(Sep 1968). (In Japanese).

It is well known that by irradiation the substance suffers chemical changes by excitation of molecules and atoms of the constituent and the enzyme having the biological activity loses its potency. In the present paper, the effect of γ irradiation on the proteolytic action of the enzyme was studied in view of the steady-state kinetics. As proteases, the following enzyme preparations were used and the activity [PU] was expressed as the amount of liberated tyrosine from the substrate, milk casein, per unit time (minute) and per unit weight (g) of the enzyme preparations. Bioprase-Enzyme produced by Bac. subtilis: [PU] 4.6×10^3, Thermoase-Enzyme produced by Bac. subtilis: [PU] 2.6×10^4, Kemipron-Enzyme produced by Streptomyces griseus: [PU] 2.3×10^4, Hiirotake enzyme preparation-Enzyme produced by Trametes sanguinea: [PU] 1.3×10^4, Sperm whale pancrease enzyme: [PU] 4.1×10^4. First, the experimental conditions, i.e., optimal pH and concentration of the substrate in the enzyme reaction, were de-

termined. By the measurement of reaction velocities depending on the zero order and first order reactions under the presence of excess substrate against the enzyme (condition of being capable of obtaining the maximum enzyme action), initial velocity V from the former reaction and velocity constant k from the latter reaction were calculated. From these values, the activation energy E was calculated by means of Arrhenius plots of both the relations of log V−1/T and log k−1/T. The values of E calculated from both the relations approximately corresponded each other and although the enzymes were irradiated in large doses, the values of E were almost unchanged as compared with those of the native enzymes. When values of E were obtained, using the equations of the absolute rate process, it was possible to calculate ΔF, ΔH and ΔS of the activated processes of the enzyme reactions. Also, these values of the γ-irradiated enzymes were almost unchanged compared with those of the native enzymes. These phenomena were considered due to the native enzyme maintaining the proper activity even with γ irradiation of large doses. (auth) (NSA of Japan)

34081 INHIBITION OF HEPATIC MICROSOMAL ENZYMES BY ALKYLATING AGENTS. Tardiff, R. G.; Dubois, K. P. (Univ. of Chicago). Arch. Int. Pharmacodyn.; 177: 445-56(1969).

The effects of radiomimetic drugs on the synthesis of hepatic microsomal enzymes in the livers of weanling and adult male rats were studied. This study was stimulated by the previous finding in this laboratory that x irradiation inhibited the normal development of microsomal enzymes in the livers of young male rats. Cyclophosphamide (Cytoxan®) and mechlorethamine (HN_2) were chosen for this study as representatives of the nitrogen mustards. A chemically unrelated antineoplastic drug, Vercyte®, was included. None of the drugs were effective inhibitors of N-demethylase, O-demethylase, or the phosphorothioate detoxification system in vitro indicating that they do not react directly with microsomal enzymes. However, after sublethal doses were given intraperitoneally to 23-day-old male rats the drugs inhibited the increase in activity of N-demethylase and the phosphorothioate detoxification system that usually occurs in young male rats. Although O-demethylase activity did not increase after 23 days of age, the drugs decreased the activity of this enzyme. Administration of the drugs to adult rats caused decreases in the activity of all of the enzymes. The time of maximal inhibition was delayed and the effect was relatively persistent. From a practical standpoint the inhibitory effect of alkylating agents on microsomal enzymes would be expected to alter the metabolism and, consequently, the toxicity of many other drugs. The administration of other drugs during therapy with radiomimetic drugs should, therefore, take into consideration the possibility that the levels of detoxification enzymes have been depressed and that the toxicity of other drugs may be potentiated. (auth)

34082 HISTOCHEMISTRY OF PURKINJE CELLS IN EXPERIMENTAL HOMOGENIZATION NECROSIS. Kozik, Miroslaw (Medical Academy, Poznan, Poland). Pathol. Eur.; 4: 122-37(1969).

Homogenization changes in Purkinje cells were experimentally produced by x irradiation of rat brains with a dose of 40,000 R, and the histochemical enzyme pattern was studied. The following enzymes were investigated: several dehydrogenases, phosphatases, esterases and sulfatases. From the results of these investigations it is concluded that in the Purkinje cells showing homogenization changes as a result of high-dose x irradiation the following enzyme activities increase: reduced NAD and NADP dehydrogenase, glucose-6-phosphate dehydrogenase and ATP-ase, β-hydroxybutyrate dehydrogenase, succinate dehydrogenase and arylsulphatase activities become apparent in the necrotic Purkinje cells. The activity of nonspecific esterase is reduced. The observed differences in the enzymatic pattern of the degenerated Purkinje cells suggest that the mechanism of homogenization changes induced by x irradiation is distinct from that responsible for the necrotic changes caused by ischemia and hypoxia. (auth)

34083 SOME ASPECTS OF THE TAURINE METABOLISM AND THE RADIOSENSITIVITY OF MICE. Streffer, C. (Univ., Freiburg i. B.). Atomkernenergie; 15: 68-71(1970).

After the irradiation of mammals, changes of the taurine metabolism take place. It has been discussed that this amino acid plays a role in the severity of radiation sickness. The reported data show that the taurine excretion in the urine and the cysteine oxygenase activity in the liver varies to a high degree between different strains and sex of mice. These two metabolic parameters can also be changed by estrogens and by adrenalectomy. The radiosensitivity of mice was influenced by these factors, too. In all investigated cases the survival rate after whole-body irradiation rose with increasing taurine excretion and cysteine oxygenase activity. (auth)

34084 ULTRASTRUCTURAL MYOCARDIAL CHANGES IN THE TOTAL BODY-IRRADIATED ALBINO RAT. Notario, A.; Bobbio, Pallavicini, E.; Marciano, S.; Scaglione, P. (Univ., Pavia, Italy). Minerva Radiol.; 14: 394-403(Sep 1969). (In Italian).

Ultrastructural myocardial pictures were examined in the albino rat following high-dose and repeated low-dose total-body x irradiation. The most meaningful alterations were observed after prolonged treatment; these involved the mitochondria and, in more general terms, the arrangement of the sarcoplasm and the endoplasmatic substances. Mitochondrial changes included a fairly frequent tendency towards emptying of the matrix, areas of vacuolization, crest irregularities, and myelinic degeneration forms. In addition, there was a tendency for the mitochondria to accumulate in plaque formations in abundant sarcoplasm, preferentially arranged around the mitochondria and not around the nucleus; the latter, indeed, being primarily found between the microfibrils with a scarce sarcoplasm. (auth)

34085 EFFECT OF X RAYS ON THE ELECTRICAL CONDUCTANCE OF PHOSPHOLIPID BILAYER MEMBRANES: A RETRACTION. Sutton, A. M.; Rosen, D. (Chelsea Coll. of Science and Tech., Eng.). Nature (London); 225: 274(17 Jan 1970).

The authors state that all the results in their previous communication (Nature; 219: 153(1968)) are incorrect and arose from experimental errors depending on air ionization and electrostatic fields due to the x-ray machine. In carefully controlled experiments they find no x-irradiation effects on the membranes at dose rates up to 900 R/min. (UK)

34086 INFLUENCE OF AET ON THE ACTIVITY OF SOME SERUM ENZYMES IN NONIRRADIATED AND IRRADIATED DOGS. Kourilek, K.; Arient, M.; Dienstbier, Z.; Kyral, V.; Pospisil, J. (Central Military Hospital, Prague. Charles Univ., Prague). Atomkernenergie; 15: 78-80(1970).

The influence of intravenous administration of AET upon the activity of serum enzymes GOT, GPT, alkaline phosphatase, LDH and its isoenzymes in serum of dogs nonirradiated and irradiated with a dose of 600 R of x rays was followed. It was found that the irradiation only mitigated the activities of most enzymes while, on the contrary, after prophylactic administration of AET an increase occurred. From the dynamics of enzymatic changes, the injury to liver functions in the first place are taken into account. In the work, possible mechanisms of the effects of AET are discussed. (auth)

34087 STUDIES ON THE IRRADIATION CLEAVAGE OF TRIMETHYLAMINE OXIDE IN FISH FLESH. II. ACCELERATION OF DMA FORMATION BY ADDITION OF GADOID FISH VISCERA. Tozawa, Harumi; Amano, Keishi (Tokai Regional Fisheries Research Lab., Kachidoki, Japan). Nippon Suisan Gakkaishi; 35: 397-404(Apr 1969). (In Japanese).

The amount of dimethylamine (DMA) produced during γ irradiation was higher in the flesh of gadoid fishes than that in shark or cuttle fish, and in some cases it was even higher than the amount of DMA found in pure trimethylamine oxide (TMAO) solution irradiated under identical conditions. Origin of this extraordinarily large DMA formation was investigated. The tissues of gadoid fishes, especially the viscera, are known to contain an enzyme system able to convert TMAO into DMA and formaldehyde. It was presumed that the enzyme might be implicated in DMA formation in gadoid fishes as a promoting factor during irradiation. This presumption was supported by the findings of experiments on a cod flesh-cod viscera mixture (20 : 1) subjected to irradiation at 3.0 MRad. Formation of DMA during the irradiation in cod or Alaska pollack flesh was markedly accelerated by the addition of the viscera of these fishes, especially by cod pyloric cecum. A similar acceleration was also observed in the samples of horse mackerel flesh or TMAO solution and cod pyloric cecum. This acceleration effect never occurred when the pyloric cecum was heat-processed before adding it to the flesh. The effect was very weak when cod flesh was mixed with pyloric cecum of horse mackerel, skipjack, and gurnard or hepatopancreas of carp. These tissues were assumed to possess little enzyme activity concerned with DMA formation from TMAO. No acceleration effect was observed when the irradiation of flesh or pyloric cecum was conducted separately, or either of these materials was irradiated alone, prior to the preparation of the mixture. Thus, the acceleration occurred during and not after irradiation, suggesting that the process may depend on the free radicals generated during irradiation. (BBB)

34088 EFFECT OF RADIATION ON THE PERMEABILITY OF THYMOCYTE NUCLEI. Tarshis, M. A.; Kuzin, A. M.; Burd, G. I. (Inst. of Biological Physics, Pushchina-na-Oke, USSR). Dokl. Akad. Nauk SSSR; 188: 700-3(21 Sep 1969). (In Russian).

In view of the known, large, radiation-induced changes in the physico-chemical properties of intracellular membranes, experiments were carried out to determine the penetrability of membranes separated from irradiated organisms and of membranes after in vitro irradiation. The nuclei were isolated from the thymus of white rats; the irradiation was carried out with a ^{137}Cs γ source at doses of 1000 R. The penetrability was determined by the rate of impregnation of the membranes with ^{14}C-labeled glucose. It was found that the exposed nuclei were saturated at a faster rate than the control specimens. The results clearly indicated that irradiation increases the penetrability of the nuclear membranes. In the experiments with glucose the radiation probably increases the glycolysis leading to increased consumption. It was concluded that changes in the penetrability of the membranes after exposure to ionizing radiation are the chief cause of the disturbances of the cells energy valence. (TTT)

34089 EFFECTS OF GAMMA IRRADIATION ON WHEAT GLUTEN. PART 7. Doguchi, Masao (Tokyo Metropolitan Hygienic Research Lab.). Agr. Biol. Chem. (Tokyo); 33: 1769-74(Dec 1969).

The effects of γ irradiation on wheat gluten were studied by means of gel filtration on Sephadex G-100, starch gel electrophoresis and analysis of amino acid composition. Analyses of gluten at a moisture content of 2% revealed no significant change in amino acid composition except for cystine which was decreased by about 8% with irradiation at 10 Mrad. Changes in the chromatogram from gel filtration were interpreted in terms of random depolymerization resulting from irradiation. The results of starch gel electrophoresis suggested that irradiation levels greater than 3 Mrad resulted in characteristic changes in the molecular configuration of gliadin components. (NSA of Japan)

34090 TRANSCRIPTION ON IRRADIATED DNA. Hagen, U.; Ullrich, M.; Jung, H. (Kernforschungszentrum, Karlsruhe, Ger.). Int. J. Radiat. Biol.; 16: 597-601(1969).

The amount of mRNA synthesized on DNA by RNA polymerase is reduced by uv light or ionizing radiation. The overall number of RNA molecules synthesized on γ-irradiated DNA, whereas the decrease in chain length of RNA, observed after irradiation of the DNA primer, almost equals the loss of total RNA synthesis. The capacity of DNA to bind RNA polymerase is almost unaffected by irradiation. Only high radiation doses lead to the formation of new binding sites, which may be ineffective for RNA synthesis, but this mechanism contributes to less than 10% of the overall inactivation of DNA priming activity. It is not possible to determine the yield of inactivated molecules per unit of dose. A procedure is described by which the number of critical lesions that stop the RNA polymerase synthesizing mRNA along the DNA molecule may be calculated. (UK)

34091 STUDIES ON THE RATE OF UV INACTIVATION OF TRYPSIN AS MEASURED BY THREE DIFFERENT ASSAY METHODS. Ghiron, C. A.; Sellers, D. R. (Univ. of Missouri, Rolla). Photochem. Photobiol.; 11: 141-3(Feb 1970).

The rate of trypsin inactivation by ultraviolet radiation was studied as a function of wavelength as measured by three different assays. Hemoglobin, benzoyl-L-arginine ethyl ester (BAEE) and casein assay methods were used. No difference between the casein and BAEE methods were observed, but the quantum yields measured by the hemoglobin methods were significantly higher at all wavelengths. The difference was explained by postulating two photochemical reactions, the first leading to an inactive class of molecules and the second leading to an unstable but enzymatically active (damaged) class of molecules, and assuming that the 5M urea in the hemoglobin substrate mixture inactivated the damaged class. (UK)

34092 LATE FUNCTIONAL EFFECTS WITHIN CARBOHYDRATES AFTER IRRADIATION DURING PRENATAL DEVELOPMENT. Rudnicki, T.; Trojczuk, D. (Zaklad Radiobiologii AM, Poznan, Poland). Acta Physiol. Pol.; 21: 121-33(Jan-Feb 1970). (In Polish).

A study was conducted to ascertain the influence of x irradiation on the hepatic glycogen level before and after birth and glucose level in rats exposed to 270 Rads at 17 day of prenatal development. Two phases of disturbances in glycogen accumulation in liver cells were found. The first brief phase showed an increase of liver glycogen. The second phase, a late one, resulted in permanent inhibition of glycogen accumulation in the liver that persisted in postnatal life. Simultaneously the glucose level in the blood in rats irradiated during fetal development was increased. In these conditions a rapid depletion of glycogen reserve in the liver under influence of different physiopathological factors was found. A change of reactivity consisting in abnormal reactions within carbohydrates in stress conditions also occurred. (auth)

34093 ALTERATIONS OF DNA-HISTONE INTERACTIONS FOLLOWING IRRADIATION. Bauer, R. D.; Johanson, R.; Thomasson, W. A. (California State Coll., Long Beach). Int. J. Radiat. Biol.; 16: 575-81(1969).

The thermal denaturation profiles and melting temperatures (Tm) of DNA isolated from the thymus of rats that had received whole-body x irradiation (1000 R) were found not to differ significantly from those of control animals. From this, it was concluded that the irradiation of animal systems does not principally involve damage to the double-stranded character of the DNA. Irradiation injury to DNA results more likely from depolymerization. The Tm values of both isolated and reconstituted deoxyribonucleoprotein (DNP) were found to decrease after irradiation. The lowered Tm values indicated alterations in the deoxyribonucleoprotein which was attributed to damage involving the histones. Injury to the histones was shown also by gel electrophoresis. (auth) (UK)

34094 DEGRADATION OF THE DNA OF recA MUTANTS OF ESCHERICHIA COLI K-12 AFTER IRRADIATION WITH ULTRAVIOLET LIGHT. II. FURTHER STUDIES INCLUDING A recA uvrA DOUBLE MUTANT. Horii, Zen-ichiro; Suzuki, Kenshi (National Inst. of Radiological Sciences, Chiba, Japan). Photochem. Photobiol.; 11: 99-107(Feb 1970).

The uv-induced degradation of the DNA of the recA1 mutant of Escherichia coli K-12 has been further investigated. The extensive degradation was mostly prevented by an additional mutation in the uvrA gene. Furthermore, when amino acid-starved recA bacteria were irradiated and held under a condition preventing DNA replication, the DNA was degraded very little. The mode of uv-induced DNA degradation was investigated by comparing the time course of release of label from the acid-insoluble fraction of two growing cultures of a recA uvrA double mutant; the one was pulse-labeled with ^{3}H-thymidine and the other was pulse-labeled and chased thereafter for 12 min. It was found that, in spite of very little degradation of the bulk of DNA, the label incorporated into the former culture was lost rapidly from the acid-insoluble fraction, while the label incorporated into the latter culture was not. It was concluded, therefore, that breakdown of the replicating point is characteristic of recA mutants and that degradation of the bulk of DNA is induced in some way by the function of the uvrA gene. Therefore, the degradation of the major part of DNA which follows the degradation of the replicating point appears to be a secondary phenomenon. (auth) (UK)

34095 GLYCOGEN SYNTHESIS FROM LABELED PRECURSORS IN LIVERS OF IRRADIATED MICE. Berndt, J.; Krebber, K.; Kofler, E. (Univ., Freiburg i. B.). Strahlentherapie; 139: 209-16(Feb 1970). (In German).

After whole body x irradiation with 690 R 24 hrs fasted mice were injected with u-^{14}C-glucose, u-^{14}C-glycerol, 1-^{14}C-glyceryl-tripalmitate or u-^{14}C-glutamic acid, respectively. The glycogen content in the liver and the radioactivity in the liver glycogen was determined. These substances were given 60–100 min before glycogen and radioactivity determinations. The measurements were carried out over a period of 16 days following irradiation. It was shown, that all these compounds serve as glycogen precursors in irradiated mice as well as in the controls. The curve of radioactivity follows almost the same pattern as the curve of glycogen content. The specific radioactivity (cpm/μmol) of the glycogen, however, is not increased and it is supposed that these compounds do not serve as glycogen precursors at an increased rate. But rapid metabolization and endogenous dilution of the glucose precursors after the injection must be considered. (auth)

34096 COMPARISON OF THE EFFECTS OF SINGLE AND FRACTIONATED IRRADIATION ON THE PHAGOCYTIC FUNCTION OF THE RES IN NORMAL AND STARVED RATS. Antonijevic, Milos (Boris Kidric Inst. of Nuclear Sciences, Belgrade). Strahlentherapie; 139: 228-35(Feb 1970).

The effects of fractionated irradiation on the phagocytic function of the RES were investigated as was the change of phagocytic activity if the time interval between successive fractions was shortened from ten days to four days. The experiments were carried out on normally fed rats and starved rats. The animals were irradiated with single doses of 708 R and fractionated doses of 3 × 236 R. Increased phagocytic activity in all experimental groups following single and fractionated irradiation was observed. On the other hand, a shortening of time intervals of 10 days to 4 days between successive exposures did not induce any essential difference in the intensity of the phagocytic function. (auth)

34097 GROWTH INHIBITION OF FETAL LIVERS AND PLACENTAS IN RATS THROUGH IONIZING RADIATION. Mitznegg, P.; Heim, F.; Saebel, M.; Pauly, H. (Univ., Erlangen, Ger.). Strahlentherapie; 139: 251-7(Feb 1970). (In German).

Rats received a dose of 500 Rad γ radiation between the 16th and 20th day of pregnancy and were sacrificed at the 22nd day. The DNA synthesis was significantly reduced in the fetal liver, whereas the RNA and protein synthesis proceeded at a reduced rate and at normal speed. Radiation damage to the placenta occurred during the days when growth was reduced. After fractionated irradiation of 100 Rad daily between the 16th and 20th day, radiation damage to the fetal liver was reduced, but the placental lesions were more pronounced. (auth)

34098 SOME STRUCTURAL AND FUNCTIONAL CHARACTERISTIC OF GAMMA-RAY-IRRADIATED HUMAN IMMUNOGLOBULIN G. Hollan, Susan R.; Gergely, J.; Medgyesi, G. A.; Igali, A.; Horvath, E. (National Blood Service, Budapest). pp 113-14 of Radiation and the Control of Immune Response. Vienna; International Atomic Energy Agency (1968).

From Panel on Radiation and the Control of Immune Response, Paris, France. See STI/PUB-175; CONF-670669.

Evidence showed that a sterilizing dose (1.5 mRad) of γ irradiation did not destroy the anti-D and staphylococcus alpha antitoxin activity of IgG when irradiated in freeze-dried state. In contrast to this the non-specific tissue-binding capacity of the irradiated IgG is considerably decreased. Irradiation induces aggregation of the IgG molecules. In contrast to heat-aggregated IgG, which is more susceptible to papain digestion, irradiated IgG is resistant to papain in absence of cysteine. (auth)

34099 MACROMOLECULAR BASIS OF RADIATION-INDUCED LOSS OF VIABILITY IN CELLS AND VIRUSES. Kaplan, Henry S. (Stanford Univ., Palo Alto, Calif.). pp 69-94 of Actions Chimiques et Biologiques des Radiations. /Haissinsky, M. (ed.). Paris; Masson et Cie, Editeurs (1968).

Included in the review is evidence relevant to the macromolecular identity of the target material (material inactivated by radiation that causes loss of viability in cells and viruses), the nature of the radiobiochemical lesions produced by ionizing radiation in the target macromolecules, the relation of such lesions to cell death, the influence of various parameters on susceptibility, and the existence of mechanisms for the repair of radiobiochemical damage. The discussion is largely limited to effects produced by ionizing radiations with specific examples drawn from work with uv radiation and radiomimetic chemicals. It was concluded that present evidence suggests that both single- and double-stranded scissions occur in DNA, but that the former, though more numerous, are not ordinarily lethal in wild-type bacterial cells because of the existence of an efficient repair system and that in bacterial mutants and viruses, and in wild-type bacteria grown under conditions that inhibit repair, single-strand lesions probably contribute significantly to lethality. The role of specific injury to purine and pyrimidine bases is also discussed. (174 references). (C.O.)

34100 EFFECT OF WHOLE-BODY X-IRRADIATION OF GUINEA PIGS ON LIVER RIBONUCLEIC ACID SYNTHESIS. Hidvegi, E. J.; Boeloeni, Elisabeth; Holland, J.; Antoni, F.; Varteresz, V. (Inst. for Radiobiological Research, Budapest). Biochem. J.; 116: 503-14(Feb 1970).

Liver RNA synthesis was studied within 24 hr after whole-body x irradiation of guinea pigs that had been starved for 22 to 24 hr. Microsomal RNA was labeled in vivo for 3 hr with [^{14}C]orotic acid and the isolated labeled RNA was fractionated by sucrose-density-gradient centrifugation. Incorporation was 50 to 100% higher between 3 and 12 hr after 2000 rad x irradiation and at 22 hr was not elevated any further. Whole nuclear RNA was labeled with [^{14}C] orotic acid for 15 min. At 5 hr after irradiation the incorporation showed a 50 to 100% increase. Incorporation increased in all types of RNA studied. The RNA phosphorus/DNA phosphorus ratio of whole liver gradually increased after x irradiation. Maximal increase was found between 24 and 36 hr which corresponds to a value about 40% above that of the starved control. The RNA phosphorus content of isolated ribonucleoproteins obtained from various cell fractions of the liver was similarly increased after x irradiation. Liver microsomes were obtained from x-irradiated and control animals. Microsomes were incubated in vitro with [^{14}C]phenylalanine in the presence and absence of polyuridylic acid. After the incubation the microsomes were fractionated by sucrose-density-gradient centrifugation. The polyuridylic acid enhancement was twice as great in the microsomes of the control preparation as in the irradiated one. The experiment demonstrated a higher saturation of microsomes by endogenous messenger after x irradiation. RNA polymerase activity of the purified nuclear preparation was assayed. The activity of the Mg^{2+}-dependent RNA polymerase activity was 50 and 200% respectively above the control values at 6 and 9 hr after x irradiation. Animals were treated with actinomycin D shortly before x irradiation. This treatment abolished the radiation-induced enrichment of polyribosomes and the increase of protein-synthesizing activity. The effect of x irradiation on the transcription of the genetic code of the liver is discussed. (auth) (UK)

34101 DEGRADATION OF INSECTICIDES BY ^{60}Co GAMMA RADIATION. Lippold, P. C.; Cleere, J. S.; Massey, L. M. Jr.; Bourke, J. B.; Avens, A. W. (Cornell Univ., Geneva, N. Y.). J. Econ. Entomol.; 62: 1509-10(Dec 1969).

Six drugs were γ-irradiated using a 6,000 Ci ^{60}Co source, and solutions were analyzed by means of a gas chromatograph with an electron capture detector. Bioassay with Drosophila melanogaster showed a decreased toxicity of insecticides degraded by 5 Mrad. Following 18 hrs exposure to the irradiated insecticides, as compared with controls, the mortality of Drosophila was decreased from 40 to 0% in the case of DDT; from 97 to 64% in the case of parathion; from 98 to 17% in the case of endosulfan; and from 79 to 0% in the case of malathion. Binapacryl and tetradifon were also tested but were not toxic to Drosophila. (H.L.W.)

34102 EFFECTS OF GAMMA- AND X-IRRADIATION ON NUCLEOTIDES OF LYMPH NODES. Jozwiak, Zofia; Maluszynska, Krystyna; Kulamowicz, Irena; Koter, Maria; Olinski, Ryszard; Leyko, Wanda (Univ. of Lodz, Poland). Int. J. Radiat. Biol.; 16: 433-40(1969).

Calf lymph nodes were subjected to γ and x radiation, and the following compounds were estimated by column chromatography: NAD, CMP, AMP, NADP, GMP, UMP, ADP, UDP, ATP, GTP, UTP. Irradiation of lymph nodes with x rays was carried out using Scandia apparatus, Type TA 310. Energy doses were estimated by x-ray chamber and calculated theoretically. Maximal increase of AMP, ADP, ATP and sum of adenine nucleotides of about 150 per cent (control 100 per cent) was observed at about 1.5 krads. Irradiation with γ rays from a ^{60}Co source (Gamma cells-200) was performed in the range of 0.3 to 40 krads. Doses were estimated, using a Fricke dosemeter and also calculated theoretically. For the dose of about 2 krads the maximum increase of all adenine nucleotides of about 150 per cent was observed. Other nucleotides increased simultaneously. It is suggested that the observed effects are due to the release of enzymes from lysosomes, beginning at about 2 krads. (auth) (UK)

34103 EFFECTS OF γ-RADIATION ON THE RIBOSOMES OF E. COLI. Ekert, B.; Pattein, A. (Fondation Curie, Paris). Int. J. Radiat. Biol.; 17: 47-59(1970). (In French).

Escherichia coli ribosomes were irradiated with gamma radiation from ^{60}Co. Both binding and transfer capacities of these ribosomes are inactivated according to an exponential function of the dose of radiation. The binding capacity is less radiation sensitive than the transfer capacity. Both capacities are made more radiation sensitive when the 70 S particles are dissociated into 50 S + 30 S sub-units, either before or after irradiation. Radiation-inactivated ribosomes maintain entirely their ability to dissociate and re-associate. No structural modification has been brought to light by the method of ultracentrifugation. (auth) (UK)

34104 THE INTERACTION OF CAFFEINE WITH ULTRAVIOLET-LIGHT-IRRADIATED DNA. Domon, M.; Barton, B.; Porte, A.; Rauth, A. M. (Univ. of Toronto). Int. J. Radiat. Biol.; 17: 395-9(1970).

The results for the U.V.-induced stimulation of the interaction of caffeine, adenine and thymine with DNA, indicated a different effect for each base. In the case of caffeine, U.V.-irradiation of DNA increased the interaction of caffeine to a maximum level greater than that observed for fully-denatured DNA, and occurring at a point where approximately 50% of the hyperchromicity of the DNA remained. Further irradiation to a level which destroyed all secondary structure decreased the interaction of caffeine to the level observed for completely denatured DNA. In the case of adenine, U.V.-irradiation stimulated its interaction with DNA, but with kinetics that appeared directly related to the percentage of DNA denatured. The failure of thymine to interact with either native or denatured DNA in either the irradiated or unirradiated state indicated that the ability to interact with U.V. irradiated DNA is not a general property of all bases. (UK)

34105 ACETIC AND PROPIONIC ACID PRODUCTION FROM γ-IRRADIATED DRY PROTEINS. Friedberg, F.; Riesz, P. (Howard Univ., Washington, D. C. National Institutes of Health, Bethesda, Md.). Contract AT(30-1)-2735. Radiat. Res.; 42: 446-50(Jun 1970).

Acetic and propionic acid production from polyalanine, polyglycine, silk fibroin, and alpha-chymotrypsinogen A upon exposure in the solid state in vacuo to gamma rays has been determined by gas chromatography. The G values for the yield of propionic and acetic acid from alpha-chymotrypsinogen A are 0.21 and 0.19, respectively, and those from silk fibroin 0.7 and 0.7, respectively. This compares to the yield of acetic acid from polyglycine with a G value of 1.0 and the yield of propionic acid from polyalanine

with a G value of 1.2. Comparison of these values on the basis of glycine and alanine content within the two proteins allows a closer correlation. The substantial yield of gamma ray-induced main-chain scissions (inferred from fatty acid production) in globular proteins and the absence of a decrease in molecular weight suggest the formation of intramolecular bonds by recombination of the long-lived radicals when the protein is dissolved after radiolysis. (auth)

34106 SPIN TRANSFER IN GAMMA-IRRADIATED NUCLEOTIDE COMPLEXES. Gregoli, Silvano; Olast, Martial; Bertinchamps, Albert (Univ. Libre, Brussels). Int. J. Radiat. Biol.; 17: 39-46(1970).

E.S.R. studies have shown that the spins induced by γ-irradiation in equimolar complexes between purine and pyrimidine nucleotides localize preferentially on the pyrimidine moiety. Considering the way the molecules are associated in the complexes, it is suggested that the spin migration occurs vertically across the stacking rather than horizontally via the hydrogen bonds. The suggestion is also made that this migration of damage occurs, at the anionic stage of radical formation, by the transfer of an electron towards the nucleotide having the empty molecular orbital of lowest energy. (auth) (UK)

34107 EVIDENCE FOR A NEW BIOLOGICAL EFFECT OF LOW-LEVEL IRRADIATIONS. Comorosan, S.; Vieru, S.; Sandru, D. (Fundeni Clinical Hospital, Bucharest). Int. J. Radiat. Biol.; 17: 105-15(1970).

When a substrate S of a particular $E_{(S)}$-enzyme is irradiated with very low doses (u.v.-light or x-rays in the range of 10^3–10^4 erg/mm^2) and then tested in the corresponding enzymic reaction, dose-dependent oscillations in the activity of the $E_{(S)}$-enzyme are recorded. The oscillatory behavior of enzymic activity induced with substrates subjected to low-level irradiations proved to be a general effect. This effect could be transmitted from an irradiated substrate (S_1) to another unirradiated substrate (S_2) through an "intermolecular transfer" of the radiation-sensitized reaction type. The oscillations induced in the activity of two different enzymes sharing the same "energized" substrate are non-overlapping, resulting in a typical chemical "flip-flop." An investigation of this type of "flip-flop" in irradiated animals is also presented. (auth) (UK)

34108 DETECTION OF RADIOINDUCED VITAMIN B_6 DEFICIENCY IN MAN. Ladner, H.-A.; van de Weyer, K.-H. (Univ., Mainz). Fortschr. Geb. Roentgenstr. Nuklearmed.; 112: 382-8 (Mar 1970). (In German).

Increase in xanthuric acid concentration in 24-hour urines and increased values of erythrocyte glutamate-oxalacetate-transaminase activity with pyridoxal-5-phosphate during the course of irradiation of patients with malignant tumors is definite evidence for radiation-induced vitamin B_6 deficiency. This was suspected as a result of experiments involving whole-body irradiation of small animals, but was demonstrated for the first time on irradiated patients. The significance of radiation induced vitamin B_6 deficiency for the patient is discussed. (auth)

34109 VARIATION IN CARBOHYDRATES DURING GERMINATION (IN DARK) OF γ-IRRADIATED CASTOR SEEDS. Thanki, R. J.; Patel, K. C.; Patel, R. D. Staerke; 21: 24-7(Jan 1970).

Carbohydrates are not detected in the resting castor seeds, but are found to develop during germination. The production of starch, amylose, total sugar and reducing sugars was explained on the basis of fat metabolism. Variation in these carbohydrates depends on ascorbic acid, amino acids, and fat utilization during germination of the control and irradiated seeds. Pregermination γ-irradiation was found to affect the formation and the metabolism of carbohydrates in castor seeds. Various dosage levels have different effects on the development of the seeds. The formation of different metabolites does not only depend on the growth of the seedlings but on their mutual effects on each other. (auth)

34110 THE CONTROL OF POST IRRADIATION DNA BREAKDOWN IN MICROCOCCUS RADIODURANS. Dean, C. J.; Little, J. G.; Serianni, R. W. (Royal Cancer Hospital, Surrey, Eng.). Biochem. Biophys. Res. Commun.; 39: 126-34(8 Apr 1970).

Tritium-labeled thymidine was incorporated into the DNA of Micrococcus radiodurans and the cells were exposed to 220 Kvp x rays under conditions of anoxia. A graph is presented to show the effects of x radiation on the release of tritium from DNA during anoxia. Experiments on the effects of chloramphenicol on DNA indicated that termination of the DNA breakdown process is mediated by proteins synthesized de novo post irradiation and that DNA degradation has no absolute requirement for an exogenous energy supply, since it proceeds in cells incubated in veronal buffer. Experiments with Actinomycin D showed that the reestablishment of protein synthesis post radiation is vital not only for the termination of DNA degradation but also for the complete restitution of the DNA damage and ultimately cell survival. (H.L.W.)

34111 IMPORTANCE OF MOLECULAR CONFIGURATION FOR THE DEVELOPMENT OF RADIATION INJURY. Koch, Ruprecht (Univ., Freiburg i. B.); Moenig, Hans. Strahlenschutz Forsch. Prax.; 7: 135-47(1967). (In German).

Formation and behavior of radicals produced by ionizing radiation in biological systems are discussed. Paramagnetic spin resonance as a method for the observing of radical formation in amino acid crystals and liquid solutions is reviewed. 19 references are given. (H.B.G.)

34112 EFFECT OF VARIOUS HIGH RADIATION DOSES ON AMINO ACID METABOLISM. Streffer, Christian (Univ., Freiburg i. B.). Strahlenschutz Forsch. Prax.; 7: 149-62(1967). (In German).

In mice and rats, exposed to whole-body x radiation, two dose ranges are distinguished. Between 50 and about 300 r all animals survive; while in the 500 to 1000 r range increasing numbers of animals die with higher radiation doses. Biochemical changes, especially amino acid metabolism and enzyme activity, are different for the two dose ranges. Possible explanations for these differences are discussed and their utilization for assessment of radiation doses are mentioned. (H.B.G.)

34113 DISCUSSION CONTRIBUTION TO C. STREFFER. Horn, Werner (CCR–EURATOM, Ispra, Italy). Strahlenschutz Forsch. Prax.; 7: 163-7(1967). (In German).

Rats were irradiated with 1000 r. After the second day post-exposure, residual nitrogen, urea, and xanthoprotein increased markedly. Protein destruction by ionizing radiation produced toxic substances that resulted in renal damage or complete kidney failure. The clinical picture was not unlike those seen after large scale tissue destruction as in Crush-syndrome, burns, and hemolysis. (H.B.G.)

34114 ON THE BEHAVIOR OF FREE AMINO ACIDS IN THE BLOOD PLASMA OF LOCALLY IRRADIATED TUMOR PATIENTS. Keiderling, Walter; Ladner, Hans-Adolf; Hahn, Klaus. Strahlenschutz Forsch. Prax.; 7: 169-77(1967). (In German).

Free amino acids were determined in the blood plasma of nine healthy male individuals and nine male tumor patients. Consistently, all amino acids showed lower levels in the tumor carriers than in the controls. During and following local radiotherapy, the amino acid levels decreased even further. Discrepancies between the findings and those observed after whole-body irradiation of animals are briefly discussed. (H.B.G.)

34115 ON THE FUNCTIONAL STATE OF THE ADRENAL CORTEX FOLLOWING WHOLE BODY X-RAY IRRADIATION. Flemming, Kurt (Heiligenberg-Institut, Baden, Ger.). Strahlenschutz Forsch. Prax.; 7: 217-28(1967). (In German).

Rats were exposed to 750 r whole-body x radiation and the corticosteroid content was determined in the blood of the adrenal vein. Following radiation exposure, corticosteroids showed a biphasic increase. The first peak occurred 2½ hours postexposure and the second peak reached its maximum on the third day following radiation. There were no indications for an inhibition of adrenal excretion. The glucocorticoids showed a higher evaluation than the mineralocorticoids. Whole-body x-irradiation increased the total production of corticoids, however, their relationship is shifted in favor of glucocorticoids. (H.B.G.)

34116 STUDIES INVOLVING THE NEURAMINIC ACID METABOLISM OF DOGS FOLLOWING X-RAY IRRADIATION OF THEIR BRAIN WITH MASSIVE DOSES. Varga, Laszlo; Zoltan, Tamas; Okros, Jozsef; Kalovics, Maria. (Medical Univ., Szeged). Kiserl. Orvostud.; 21: 346-50(Aug 1969). (In Hungarian).

The effect of x-ray treatment with lethal doses (5000 R) on the neuraminic acid concentration in the central nervous system and in the serum proteins was studied. Five days after irradiation, there was a decrease in the neuraminic acid concentration of the serum while that of the liquor did not show any significant change. There was a decrease in the so-called total bial-positivity of the liquor. In nerve tissue (gray matter), there was no change in the neuraminic acid concentration of the ganglioside fraction; there was a considerable increase in the neuraminic acid concentration of the protein fraction following the treatment. The changes in the neuraminic acid content of nervous tissue are associated with the increased permeability of the brain-blood barrier. (JPRS)

34117 MEASUREMENT OF CHANGES IN THE OXYGEN AND CARBON CONCENTRATION OF TISSUES DURING FRAC-

TIONATED HIGH ENERGY X-RAY TREATMENT. Spring, E.; Vaeyrynen, T. (Univ. Central Hospital., Helsinki). Phys. Med. Biol.; 15: 23-8(Jan 1970).

During treatment with 33 MeV x rays from a medical betatron, the tumor and normal tissue of the irradiated region are activated by photon-neutron reactions, mainly $^{16}O(\gamma,n)^{15}O$ and $^{12}C(\gamma,n)^{11}C$. These give rise to annihilation radiation which is measurable after treatment. The method can thus be used to determine variations in the oxygen and carbon concentrations of both irradiated normal and tumor tissues. Measurements were made on patients undergoing a fractionated course of radiotherapeutic treatments; the results indicate a periodicity in the tumor carbon concentration, with an amplitude of about ±10% (max. ±20%) and a period between 3 and 14 days. (auth) (UK)

34118 FREE RADICALS IN BONE GRAFTS STERILIZED BY IONIZING RADIATION. Ostrowski, K.; Kecki, Z.; Dziedzic-Goclawska, W.; Stachowicz, A. Komender, A. (Inst. of Nuclear Research, Warsaw). Sb. Ved. Pr. Lek. Fak. Karlovy Univ. Hradci Kralove, Suppl.; 11: 561-3(1968).

Lyophilized or partially deproteinized bone powder was irradiated with a dose of 3.3 Mrad from cobalt source. By means of ESR the presence of free radicals in the powder was studied. An asymmetric signal with line width $H^{\prime\prime}-H^{\perp}=11$ gauss at 9.5 GHz was obtained. Concentration of the radical was about 4.5×10^{17} spin/g in all irradiated samples. No significant differences in kind, concentration and durability of free radicals between samples kept in vitro or samples removed from animals or from patients were observed. (auth)

34119 ELECTRON-MICROSCOPIC INVESTIGATION OF CHANGES IN ULTRASTRUCTURE OF THE NERVE CELLS OF THE UPPER CERVICAL SYMPATHETIC GANGLION OF A RABBIT AFTER IRRADIATION. Ferents, A. I. (Inst. of Physiology, Kiev). Fiziol. Zh., Akad Nauk Ukr. RSR; 15: 789-96(Nov-Dec 1969). (In Ukrainian).

The obtained experimental data testified to the fact that single total irradiation of rabbits by x rays in a dose of 800 R provoked a number of changes in ultrastructure of the neurons of the sympathetic ganglion. The effect of ionizing radiation did not completely inhibit the ability of ganglionic cells to regenerate, which occurs side by side with the sometimes irreversible pathological processes. (auth)

34120 DAILY PERIODICITY OF CELL FUNCTIONS AND RADIATION SENSITIVITY IN NORMAL AND TUMOR TISSUE. Rensing, Ludger (Zoologisches Institut, Goettingen, Ger.). Naturwiss. Rundsch.; 22: 390-4(Sep 1969). (In German).

Correlations between cell functions with daily rhythms and changes of the sensitivity toward x irradiation are described. Cell functions examined are cell division and DNA synthesis, RNA and protein synthesis, and energy exchange. Data for the mouse and the rat are related. Correlations in Drosophila for O_2 consumption, nuclear size of the neurosecretory cells, and sensitivity to x irradiation (5000 and 10,000 R) are described. The influence of x rays on cellular processes is reviewed, and current concepts explored; emphasis is laid on the enhancement of the effects of irradiation by the presence of O_2; the influence of irradiation on a synchronized cell culture is greatest during the S phase for lowering DNA synthesis, but other parameters are affected most during the G_1, G_2, and M phases. Possible causal relations between daily rhythms of cell function and rhythms in the sensitivity to radiation are explored. (BBB)

34121 BREAKDOWN OF RIBOSOMAL RNA CAUSED BY IONIZING OR ULTRA-VIOLET IRRADIATION OF SEVERAL BACTERIAL STRAINS. Pecevsky-Kucan, I.; Kucan, Z. (Inst. Ruder Boskovic, Zagreb). Int. J. Radiat. Biol.; 17: 163-71 (1970).

Post-irradiation breakdown of RNA was studied in five strains of Escherichia coli. The breakdown was not dependent on the dose-rate; oxygen enhanced the effect by a factor of 3.4. In all strains of E. coli, regardless of the dose of x-radiation, the breakdown proceeded after a lag of 30 min; the rate of the breakdown was dose-dependent and the same for all the strains examined at doses up to 19 krads. Radio-resistant strains were able to degrade more RNA than radiosensitive ones if higher doses were applied. Micrococcus lysodeikticus revealed a post-irradiation breakdown of RNA similar to that in E. coli, whereas M. radiodurans showed a marked stability of its RNA in spite of doses ten times higher being used. Ultra-violet light was able to cause a similar breakdown of RNA in E. coli. (auth) (UK)

34122 CHARACTERISTICS OF LIVER ULTRASTRUCTURE FOLLOWING EXPOSURE TO AN ELECTROMAGNETIC FIELD. Zufarov, K. A.; Shneyvays, V. B. (Tashkent State Medical Inst.). Arkh. Anat., Gistol. Embriol.: No. 8, 47-50(1969). (In Russian).

An electron-microscopic study of the liver in rats exposed at an electromagnetic field (1625 kHz) for varying lengths of time is reported. A 30-minute exposure markedly intensified the metabolic processes in the cells, giving rise to changes in the endoplasmic reticulum, nucleus, and Golgi apparatus. A 3-hour exposure resulted in the appearance of very large mitochondria with well-developed cristae. New mitochondria resulted from budding and formation of membrane structures. Daily exposures over a period of time (10 to 15 days) led to deeper destructive changes in some cells and a pronounced shrinkage of the mitochondria, possibly because of the substantial energy consumption of the cells. Other changes were related to the processes of regeneration and compensation. Thus, despite the considerable specificity of the exciting agent and some specific changes in the ultrastructure, the cellular reactions were largely the same as those observed after the action of many other environmental factors. (JPRS)

34123 MELANOGENESIS: ULTRASTRUCTURAL HISTOCHEMICAL OBSERVATIONS ON ULTRAVIOLET IRRADIATED HUMAN MELANOCYTES. Hunter, John A. A.; Mottaz, Jess H.; Zelickson, Alvin S. (Univ. of Minnesota, Minneapolis). J. Invest. Dermatol.; 54: 213-21(Mar 1970).

Ultrastructural DOPA and tyrosine reactions were used to provide information regarding subcellular sites of melanogenesis within the melanocyte following ultraviolet irradiation of normal human skin. Observations indicated that the earliest premelanosomes arise from all parts of the Golgi apparatus as well as from a Golgi associated system of smooth endoplasmic reticulum (GERL). The time interval following irradiation influences the site of enzyme activity. The role of the Golgi apparatus in melanogenesis is discussed, and special attention is drawn to the fact that some premelanosomes frequently show no tyrosinase activity, even though some enzyme activity may be present in neighboring vesicles. (auth)

34124 THE RECOVERY IN VIVO OF DNA SYNTHESIS FOLLOWING RADIATION. Looney, W. B.; Chang, L. O. (Univ. of Virginia, Charlottesville). Cancer Res.; 29: 1156-8(May 1969).

X radiation was administered locally to the liver of rats at the rate of 300 R per minute, with the remainder of the animal shielded. All radiation was given between 20 hours and 55 minutes and 21 hours after partial hepatectomy. Six rats were used routinely for each point. Fifty μc of tritiated thymidine, with a specific activity of 3 Ci/nmole in 1 ml of normal saline solution, were injected intravenously. Tritium-labeled thymidine was given at 0, 8, 24, and 48 hours after the end of radiation, and the animal was sacrificed 30 minutes later. The maximum depression of DNA synthesis in individual cells, measured autoradiographically, occurred eight hours after irradiation, with recovery at 24 hours. The maximum depression of the percent labeled cells was at 24 hours, with only partial recovery at 48 hours. The maximum depression of DNA synthesis in the total population of cells, measured biochemically, was also at 24 hours, with partial recovery at 48 hours. The correlation between percent labeled cells and specific activity of the liver DNA was also demonstrated in the 0- and 8-hour control values. Between 21 and 29 hours after partial hepatectomy, the percent labeled cells was reduced from 12.7 to 2.7%, or approximately a fifth of the 21-hour values. The specific activity of liver DNA was reduced from 72,940 cpm/mg DNA to 13,570 cpm/mg DNA, which was also approximately a fifth of the 21-hour values. There was a reduction of the rate of DNA synthesis measured autoradiographically in individual cells of 0, 11, and 21 percent respectively for total doses of 94 R, 750 R, and 1500 R. Eight hours after irradiation, 11, 31, and 36% reductions were found after 94 R, 750 R, and 1500 R respectively. The major part of the total reduction of DNA synthesis occurred within two to four minutes after the end of irradiation. There was a slight downtrend in the rate of DNA synthesis between four and 256 minutes. The results of this study indicate that this downtrend also continued up to eight hours before recovery began. The depression of the percent of labeled cells was 12, 5, and 9% for total doses of 94 R, 750 R, and 1500 R respectively. (C.H.)

34125 CHANGES IN CHLOROPLAST FINE STRUCTURE AFTER X IRRADIATION OF ETIOLATED BEAN LEAVES. Devide, Z. Oesterr. Bot. Z.; 116: 444-53(16 May 1969). (In German).

Effects of irradiation with doses of 5 to 10 kR of x ray were studied in etiolated leaves of Phaseolus vulgaris. Changes produced in the fine structure of the leaves were established to be results of irradiation of the leaf tissue itself and not because of injury of the entire plant. The transformation processes of

the prolamellar bodies, including the weak light prolammellar bodies were not affected by irradiation, even at doses of 100 kR. The tylacoid development and greening of the plastids and the formation of the granular fibers were inhibited or delayed in proportion to the irradiation dose given. However, the tylacoid development and re-greening was resumed again during further development of the leaves, even after exposure to doses of 100 kR, although the chloroplasts remained small. After greening of the plants the irradiated leaf arrangements had brighter color. This was due to the smaller size and lesser numbers of chloroplasts in each cell, and the reduced sizes of the palisade cells, as well as the more compact position of the smaller intercellular spaces, which caused a more intense total reflection of the light. (BBB)

34126 TISSUE RESPIRATION AND THE CYTOCHROMIC SYSTEM OF MITOCHONDRIA IN THE LIVER FROM THE POINT OF VIEW OF RADIOSENSITIVITY. Uteshev, A. B.; Berdina, M. A.; Satkhozhina, E. A. (Inst. of Biophysics, Pushchino-on-Oka, USSR. Inst. of Experimental Biology, Alma-Ata, USSR). Tr. Kaz. Nauch.-Issled. Inst. Onkol. Radiol.; 6: 7-9(1969). (In Russian).

Oxidative phosphorylation in liver mitochondria of guinea pigs is suppressed by a whole-body X radiation dose of 900 R. Moreover the amount of cytochrome decreases and the activity of succinic dehydrogenase increases. (auth)

34127 CONTENTS OF SULFHYDRYL GROUPS IN TWO ASCITES TUMORS OF DIFFERENT RADIOSENSITIVITY. Ismailov, B. I.; Arkhipova, L. D.; Zhemaletdinov, F. G. (Inst. of Oncology and Radiology, Alma-Ata, USSR). Tr. Kaz. Nauch.-Issled. Inst. Onkol. Radiol.; 6: 10-14(1969). (In Russian).

The content of sulphydryl groups is lower in radiosensitive tumors (Pliss ascites lymphosarcoma) than in radioresistant ones (ovary tumor in rats). The degree and duration of inactivation of the sulphydryl groups after irradiation are more marked in Pliss lymphosarcoma than in the ovary tumor. (auth)

34128 APPRAISAL OF TISSUE RADIOSENSITIVITY IN RADIATION THERAPY OF TUMOR PATIENTS IN CONNECTION WITH CHANGES OF THE SULFHYDRYL GROUP LEVEL. Ulybaeva, R. K.; Mustafina, R. Kh. (Inst. of Oncology and Radiology, Alma-Ata, USSR). Tr. Kaz. Nauch.-Issled. Inst. Onkol. Radiol.; 6: 15-16(1969). (In Russian).

The content of SH groups in the blood serum of patients with cancer of the esophagus was determined following exposure to irradiation. It was established that irradiation with large fractionated doses (700 to 800 R with intervals of 3 to 4 days) resulted in a decreased SH group content. Medium doses (400 R) did not cause significant changes in the SH group content. (auth)

34129 ROLE OF SODIUM AND POTASSIUM IN THE RADIOSENSITIVITY OF ASCITES TUMORS. Sysoeva, M. I.; Sulaeva, L. S. (Inst. of Oncology and Radiology, Alma-Ata, USSR). Tr. Kaz. Nauch.-Issled. Inst. Onkol. Radiol.; 6: 17-21(1969). (In Russian).

The metabolism of K and Na electrolytes was investigated in cells of ascites tumors (sarcoma 37 and Ehrlich carcinoma) during their growth and after irradiation (900 R), and also after irradiation response (500 R) with preliminary vicasol injection. It was found that the growth of inoculated tumors is accompanied by an accumulation of K and Na up to the 11th day after transplantation. A difference between the permeability of cell membranes for K and Na was established not only for two tumor strains irradiated at the same growth periods but also for the same strain irradiated at different times after transplantation. (auth)

34130 RADIOSENSITIVITY OF DIFFERENT CELL FRACTIONS OF ADRENAL MEDULLA. Musagalieva, G. M.; Uteshev, A. B.; Ulmanova, K. A. (Inst. of Biophysics, Pushchino-on-Oka, USSR. Inst. of Experimental Biology, Alma-Ata, USSR). Tr. Kaz. Nauch.-Issled. Onkol. Radiol.; 6: 22-4(1969). (In Russian).

X radiation doses of 1000 R to the adrenal medulla caused a decrease of the amount of adrenaline, noradrenaline, dophamine and dophe. At the same time the concentration of cytochrome b, c and b_5 decreased in the mitochondria of adrenal medulla, and the content of cytochrome b_5 in the fractions S_2, S_3 and in the microsomes increased. (auth)

34131 STUDY OF THE ISOFERMENTAL SPECTRE OF LACTATE DEHYDROGENASE IN VARIOUS ORGANS OF IRRADIATED ANIMALS. Osnach, L. A. (Inst. of Biophysics, Pushchino-on-Oka, USSR). Tr. Kaz. Nauch.-Issled. Inst. Onkol. Radiol.; 6: 25-8(1969). (In Russian).

A radiation dose of 800 R produced changes in the activity of lactate dehydrogenase (LDH) during the earliest and latest periods. The effects of whole-body radiation on the distribution of LDH isozymes in the adrenal glands, brain, and thymus were studied. Some changes were observed within 2 hrs after irradiation; after 24 hrs there was an increase in the amount of change. After 48 hrs the electrophoretic pattern was different from that which characterized earlier periods. (H.L.W.)

34132 CONTENTS OF SULFHYDRYL GROUPS IN CERVIX CARCINOMA DURING RADIATION THERAPY. Balmukhanov, S. B.; Kilyakova, L. F. (Inst. of Oncology and Radiology, Alma-Ata, USSR). Tr. Kaz. Nauch.-Issled. Inst. Onkol. Radiol.; 6: 87-9(1969). (In Russian).

The content of SH groups in homogenates from cervical carcinomas was determined before and during administration of 2,000 and 4,000 R doses of radiation. In patients with good clinical response an increased non-protein level and a decreased protein level of SH groups were found; in patients with poor response the correlations were reversed. (auth)

34133 INFLUENCE OF IRRADIATION OF SEEDS UPON CHANGES OF SULFHYDRYL GROUP LEVEL IN SPROUTS OF FODDER BEANS AND CLOVER. Seisebaev, A. T.; Mal'tsev, A. V. (Inst. of Experimental Oncology, Alma-Ata, USSR. Inst. of Biophysics, Pushchino-on-Oka, USSR). Tr. Kaz. Nauch.-Issled. Inst. Onkol. Radiol.; 6: 90-1(1969). (In Russian).

The content of sulfhydryl compounds in clover sprouts is higher than that in fodder beans. The seeds of both plants were exposed to γ radiation, and, after sprouting, the SH group level was determined. An increased level of the SH group was observed in bean sprouts following a 10 KR dose, while the increased level in clover was observed following a 200 KR dose. It was thought that the radioresistance of the plants was related to the level of SH groups. (auth)

34134 SOME INDICES OF THE CONNECTIVE TISSUE REACTION IN CANCER PATIENTS IN VARIOUS RHYTHMS OF RADIATION THERAPY. Ulybaeva, R. K.; Mustafina, R. Kh. (Inst. of Oncology and Radiology, Alma-Ata, USSR). Tr. Kaz. Nauch.-Issled. Inst. Onkol. Radiol.; 6: 271-3(1969). (In Russian).

The content of mucoids and sialic acids in the serum of patients with eosophageal and lung cancer was determined before, during, and following treatment with 400 to 800 R x radiation. The mucoid content was increased by higher x ray doses, but was decreased by lower doses. The content of sialic acids was increased by fractionated doses of radiation. (H.L.W.)

34135 POSSIBLE REQUIREMENT OF ADENOSINE TRIPHOSPHATE FOR THE REJOINING OF X-RAY-INDUCED BREAKS IN THE DNA OF EHRLICH ASCITES-TUMOUR CELLS. Matsudaira, Hiromichi; Furuno, Ikuko; Otsuka, Haruki (National Cancer Centre Research Inst., Tokyo). Int. J. Radiat. Biol.; 17: 339-47(1970).

Changes in the metabolism of Ehrlich ascites-tumor cells were examined after in vitro incubation under nitrogen at 1 atmosphere in phosphate-buffered saline in the absence of glucose, conditions which do not allow the rejoining of x-ray-induced breaks in the DNA. There was a marked reduction in the incorporation of radioactive precursors into DNA, RNA, protein, and thymidine triphosphate (TTP) under these conditions compared with incubation in air. The reduction was partially or completely abolished by adding glucose to the incubation medium. After incubation under nitrogen without glucose, the intracellular content of ATP was greatly decreased. This decrease was also partially prevented by the addition of glucose. No significant change was observed in the content of NAD in the cells incubated under similar conditions. It was concluded that ATP is probably necessary for the rejoining of x-ray-induced breaks in the DNA of the ascites-tumor cells. (auth) (UK)

34136 THE INFLUENCE OF γ IRRADIATION ON THE ACTIVITIES OF SEVERAL STARCH-DEGRADING ENZYMES IN RESTING AND GERMINATING RYE SEEDS. II. THE EFFECTS ON PHOSPHORYLASE. Bancher, E.; Washuettl, J.; Stachelberger, H. (Technische Hochschule, Vienna). Microchim. Acta; No. 2, 419-22(1970). (In German).

The phosphorylase-activity in ungerminated and germinated rye seeds in the γ-irradiated and non-irradiated state was tested. In the germination trials of the irradiated rye seeds there appeared, in contrast to the non-radiated samples, a pronounced decrease of the phosphorylase activity, which rapidly increases up to the third day and then decreases up to the eleventh day. The activity values after 500 krad are higher in all instances than after 50 krad. In storage trials of irradiated rye seeds it was possible, in comparison with the non-irradiated specimens, likewise to find a decrease of the phosphorylase-activity im-

mediately following the γ-irradiation. The course of the enzyme activities after one, three, six and eleven days is similar to that found in the germination trials. The activity values of the phosphorylase following 500 krad are higher only immediately after the irradiation and on the first day of storage are greater than after 50 krad, while on the 3rd, 6th and 11th day they lie below the values obtained with 50 krad. (auth)

34137 THE INFLUENCE OF γ IRRADIATION ON THE ACTIVITIES OF SEVERAL STARCH-DEGRADING ENZYMES IN RESTING AND GERMINATING RYE SEEDS. I. THE EFFECTS ON α- AND β-AMYLASE. Bancher, E.; Washuettl, J.; Stachelberger, H. (Technische Hochschule, Vienna). Microchim. Acta; No. 2, 413-18(1970). (In German).

Comparison trials were made of the activities of α- and β-amylase in non-irradiated and those rye seeds that have been exposed to 50 or 500 krad of radiation during various germination stages and in storage trials. It was found in the germination experiments that, in contrast to the non-irradiated controls, there was a marked decrease in the α- and β-amylase activities. In the storage experiments, a comparison of the non-irradiated and the irradiated rye seeds at the same time intervals showed with regard to their α-amylase activity an increase with a maximum value on the third storage day with subsequent decrease. The same holds likewise for the activity of the β-amylase, only with the exception that immediately after γ-irradiation with 50 krad there appears a lessened β-amylase activity in comparison with non-irradiated controls. However, for the subsequent storage time, the same holds true as for the α-amylase. (auth)

34138 FUNCTIONAL ANALYSIS OF EARLY DEFECTIVE MUTANTS OF COLIPHAGE λ. Brachet, P.; Green, B. R. (Univ. Libre, Brussels). Virology; 40: 792-9(Apr 1970).

In uv-induced λ lysogens, the presence of a defective mutation in the x region not only prevents the expression of the prophage genes C_{II} and O but also interferes with the expression of the genes P and Q. This situation is not modified by amber, ochre, or UGA suppressors. Following heteroimmune superinfection, there is a limited, but significant, expression of the prophage gene P, in λx as well as in λ^+ lysogens. This expression of the prophage gene P reaches about the same subnormal level as in an induced λx lysogen. These results show that the series of genes C_{II}, O, P, and Q constitute a unit of expression that is negatively controlled by immunity. Possible mechanisms by which gene P can be expressed in the presence of immunity are discussed. (auth)

Immunology

Refer also to abstracts 34281, 34544, 34611, and 34795.

34139 (AD-674262) A STUDY OF THE IMMUNOLOGIC ASPECTS OF THERAPY OF RADIATION INJURY IN THE SOLDIER. Final Report. Carr, C. Jelleff (Federation of American Societies for Experimental Biology, Bethesda, Md. Life Sciences Research Office). 15 May 1968. Contract DADA17-67-C-7180. 125p. CFSTI.

The study was conducted as a part of a broad review of selected problems in military medicine-research and development, to provide the Office of The Surgeon General of the Army with the most current information on the treatment of ionizing radiation injury in the soldier. These studies and their comprehensive, evaluative bibliographies will facilitate the evaluation of future research and development programs on the treatment of radiation injury and military nuclear medicine. The report includes the nature of hematopoietic injury and recovery, immunologic changes that influence bone marrow allograft transplants and the decreased resistance to infection, animal models used to study allograft responses, use of antilymphocyte sera and antilymphocyte globulin as immunosuppressive substances, and the phenomena of host-versus-graft and graft-versus-host reactions. The evidence for the reported success with leukocyte typing for donor selection is reviewed as related to bone marrow transplantation. An annotated, evaluative bibliography is included as an appendix. (auth) (TAB)

34140 (STI/PUB-175) RADIATION AND THE CONTROL OF IMMUNE RESPONSE. Panel Proceedings Series. Report of a Panel Held in Paris, 22-24 June 1967. (International Atomic Energy Agency, Vienna (Austria)). Apr 1968. 132p. (In French and English). (CONF-670669). IAEA $3.50.

Ten separate abstracts were prepared. In addition there were six other papers on immunology. The general conclusions of the panel and a list of its members are provided. (C.O.)

For abstracts of individual papers see: 34096, 34157-34163, 34421, and 34675.

34141 SEX OF SCHISTOSOME CERCARIAE AS A FACTOR IN THE IMMUNIZATION OF RHESUS MONKEYS. Hsu, S. Y. Li (Univ. of Iowa, Iowa City). Exp. Parasitol.; 25: 202-9(Aug 1969).

A strong acquired resistance against challenge infection of Schistosoma japonicum or S. mansoni in rhesus monkeys was produced by previous immunization with either male or female cercariae of the respective species. In the case of S. japonicum, the immunizing cercariae can be either nonirradiated or irradiated human strain, or nonirradiated nonhuman strain. Qualitatively there was no difference in immunogenicity between sexes of schistosome cercariae. However, a possibility existed that quantitatively male schistosomula may produce more functional antigens than female schistosomula because the former are usually better developed and larger than the latter. (auth)

34142 EXTRACORPOREAL IRRADIATION OF BLOOD. A CLINICAL STUDY IN CANDIDATES FOR RENAL TRANSPLANTATION. Rosengren, B.; Bergentz, S.-E.; Hood, B.; Lindahl-Kiessling, K. (Univ. of Goeteborg. Univ. of Uppsala). Scand. J. Urol. Nephrol.; 2: 58-61(1968).

Eleven patients waiting for homologous renal transplantation were given extracorporeal irradiation to circulating blood at doses of 9000 up to 37,000 rads over 8 up to 31 days. Only three patients exhibited a significant decrease in the lymphocyte count. No changes were seen in the white cell count or in the hemoglobulin or osmotic fragility of the red cells. Morphological changes of the cultivated lymphocytes with pycnosis of the nucleus were observed. Chromosome studies in three patients revealed translocation, ring chromosomes and break of the chromosomes. The capacity of the lymphocytes to incorporate ^{14}C-thymidine in vitro after addition of phytohemagglutinin was significantly inhibited in four of the five patients studied. Following transplantation the course of the irradiated patients was no different from that of patients given conventional immunosuppressive drugs only, but the general impression was that the rejection episodes were less frequent and violent. It is concluded that relatively high doses are necessary in order to decrease the lymphocyte count. The irradiation-induced chromosome damage as well as inhibited DNA synthesis are more sensitive indicators of the effect of the treatment. (auth)

34143 RADIATION EFFECT ON SECONDARY CANCERIZATION BY TUMOUR CELL GRAFTS: TAKE OF IRRADIATED TUMOUR CELLS IN IRRADIATED AND NON-IRRADIATED ANIMALS. Costachel, O.; Sandru, Gh.; Kitzulescu, I. (Oncological Inst., Bucharest). pp 67-81 of Radiation-Induced Cancer. Vienna; International Atomic Energy Agency (1969).

From Symposium on Radiation-Induced Cancer, Athens, Greece. See STI/PUB-228; CONF-690404.

The ability of hemocytoblastoma, SME and Jensen tumors, which were irradiated in vitro, to take in $C_{57}BL/6$ mice or Wistar rats that were whole-body irradiated at 0.4 kR and 0.6 kR respectively was studied. It was found that the take of tumor cell grafts irradiated in vitro increased in whole-body irradiated mice and rats but not in non-irradiated ones. When Wistar rats, that were whole-body irradiated with 0.7 and 0.8 kR 1 to 7 months earlier and survived after treatment, were grafted with Jensen tumor cells irradiated in vitro with 3 kR they were found to develop tumors and lung metastases (in contrast to nonirradiated rats). A cross resistance against nonirradiated Jensen tumor cells was obtained in nonirradiated Wistar rats by grafting irradiated Jensen tumor cells. Chromosomal analysis showed two supplementary giant markers in the Jensen tumor cells that were irradiated in vitro before grafting. (auth)

34144 RADIOIMMUNOASSAY FOR RHESUS MONKEY LUTEINIZING HORMONE (RhLH). Monroe, S. E.; Peckham, W. D.; Neill, J. D.; Knobil, E. (Univ. of Pittsburgh). Endocrinology; 86: 1012-18(May 1970).

A double antibody radioimmunoassay for rhesus monkey (Macaca mulatta) luteinizing hormone (RhLH) has been developed. Purified RhLH with a specific activity approximately 7 times that of NIH-LH-S1 was iodinated with ^{131}I using chloramine-T. The most useful RhLH antiserum was obtained from a guinea pig immunized with a crude RhLH preparation. The useful assay range (90 to 20% bound) was 0.12 to 2.4 ng of purified RhLH, equivalent to 0.67 to 13 ng NIH-LH-S1. The LH potency estimates of a number of pituitary preparations with widely varying ratios of LH:FSH and LH:TSH were in close agreement when measured by radioimmunoassay and bioassay (indices of discrimination 0.74 go 1.50). Dose-response curves with plasma from monkeys in various endocrinologic states were parallel to the curves obtained with pituitary LH standards, but the dose-response curve with rhesus monkey chorionic gonadotropin (RhCG), which cross-reacted but weakly, was not. (auth)

34145 MONO- AND INDOLAMINES AND CONTROL OF LH SECRETION. Schneider, H. P. G.; McCann, S. M. (Univ. of Texas Southwestern Medical School, Dallas). Endocrinology; 86: 1127-33(May 1970).

To determine the effect of biogenic amines on LH release in rats, blood samples were drawn by cardiac puncture in ether-anesthetized animals bearing chronic cannulae in the third ventricle (3rd V) immediately before and 15 min after intraventricular injection of various drugs. In the interim between removal of the 2 blood samples the rats recovered from anesthesia. Plasma LH was measured by radioimmunoassay. Serotonin (5-HT) did not alter plasma LH levels significantly at any stage of 4-day estrous cycles. Norepinephrine (NE) also failed to produce overall significant changes in plasma LH although there were some positive responses. Dopamine (DA) raised LH to levels as high as 8- or 10-fold above controls ($p < 0.01$) in rats on the 2nd day of diestrus (D2) or in proestrus (P). DA proved to be less effective in D1 or estrus (E). In normal males DA raised plasma LH in 5 out of 9 animals ($p < 0.02$), whereas NE was ineffective. The effect of DA in D2 and P rats could be blocked by simultaneous 3rd V injection of 30 μg phenoxybenzamine, but remained unaltered after the same dose of pronethalol. In spayed females NE or DA produced variable results independent of base line LH levels; however, 5-HT significantly ($p < 0.01$) decreased LH release in these animals. Estrogen progesterone-blocked castrated female rats responded with up to 10-fold increases ($p < 0.01$) in plasma LH following 3rd V injection of DA, whereas NE produced only slight increases in 5 out of 9 rats. Monitoring an individual rat of this type by drawing blood from a carotid artery catheter at 3 to 7 min intervals revealed an 8-fold increase of plasma LH 7 min after intraventricular injection of DA. Saline (0.9%) did not produce an effect on LH release under any of the described conditions. The results provide in vivo evidence for the role of DA in LH release, probably as transmitter for the release of LRF, as shown by the authors in earlier in vitro experiments. A possible inhibitory role of 5-HT is also suggested. (auth)

34146 ANALYSIS OF INITIAL AND DELAYED EFFECTS OF ORCHIDECTOMY AND OVARIECTOMY ON PITUITARY AND SERUM LH LEVELS IN ADULT AND IMMATURE RATS. Yamamoto, Makoto; Diebel, N. D.; Bogdanove, E. M. (Indiana Univ., Bloomington). Endocrinology; 86: 1102-11(May 1970).

The initial LH secretory responses to castration were examined in adult and immature rats of both sexes, using an 0:0 radioimmunoassay for rat LH. The patterns of response differed markedly between males and females. Adult males exhibited a dramatic increase in serum LH levels, which was detectable by 8 hr after gonadectomy, and reached a plateau at about 20 times pre-castration levels by 18 hr. This plateau was sustained through the fourth day; serum LH levels then increased about 4-fold further over the next month. The initial response in females was less marked and no plateau phase was evident. Although serum LH levels did not match those of comparable males during the first 10 post-castration days, they did reach or surpass them later. The pattern of pituitary LH changes also differed: in males, LH stores initially fell, reaching a nadir at about day 4; females exhibited no such fall. This sex difference in the pattern of the initial LH secretory responses to castration was evident in prepubertal castrates as well, although immature males did not respond as markedly as adult males. The weaker initial response of the female was evident in rats castrated at various times during the estrus cycle. Serum LH appeared to rise more rapidly in rats ovariectomized during diestrus than in rats spayed at other times, but no female castrate ever exhibited the very marked initial serum LH increment characteristic of the adult male. Analysis of concomitant changes in serum and pituitary LH levels suggests that LH net synthesis increased quite soon after castration, perhaps even as early as LH release (i.e., within the first 8–18 hr after gonadectomy). However, it should be emphasized that studies such as these may not accurately define the time lags in the responses of the LH secretory system to removal of steroid negative feedback signals, since surgical gonadectomy may itself influence the LH secretory response(s). (auth)

34147 EVALUATION OF ANGIOTENSIN II METABOLISM IN SHEEP BY RADIOIMMUNOASSAY. Cain, M. D. (Monash Univ., Melbourne); Catt, K. J.; Coghlan, J. P.; Blair-West, J. R. Endocrinology; 86: 955-64(May 1970).

The immunoreactive material detected in sheep arterial blood by the radioimmunoassay procedure was shown to be predominantly the octapeptide angiotensin II and to be the valine-5 form. Levels in venous blood were 60% of arterial. A reasonable proportionate relationship was demonstrated between angiotensin II and sodium loss and renin during the onset of sodium deficiency. Following a single injection of angiotensin II into sheep, the biological half-life of the peptide was found to be less than 1 min. The change in blood pressure after injection of the angiotensin II closely followed the change in angiotensin II concentration determined by the immunoassay. Continuous infusion of angiotensin II until plateaued levels were reached allowed calculation of the blood clearance rate, which was approximately 100 l/hr. Knowledge of the blood clearance rate allowed calculation of angiotensin II production rates during sodium deficiency and following renin infusion. A linear relationship existed between the different but constant rates of infusion of angiotensin II and the resultant concentrations of the peptide detected in blood. Sodium depletion, bilateral adrenalectomy and renin infusion substantially raised the concentrations of angiotensin II in blood above the sodium replete value. (auth)

34148 IMPREGNATION OF VASCULAR SUTURES AND GRAFTS WITH RADIOACTIVE PHOSPHORUS. Daugherty, C. O.; Clark, Terrence; Takaro, T. (Veterans Administration Hospital, Oteen, N. C.). J. Cardiovasc. Surg.; 10: 282-6(1969).

A new method, employing ^{32}P, was tested for preventing thrombosis in arterial grafts. Since a potential difference exists between the normal, undamaged intima of a blood vessel, and its adventitia, with the intima electro-negative and since a negative electrostatic charge is present on blood cells and platelets under normal conditions, it is suggested that blood cells do not adhere to intimal cells because they are repelled from the intima by their mutually negative electric charges. This led to the hypothesis that impregnating vascular suture material or grafts with a radioisotope that emitted negatively charged particles might prevent thrombosis. Radioactive suture material was prepared as follows from 6.0 cardiovascular silk sutures that were soaked in a fresh solution of ^{32}P (containing 5 μCi/ml). All of 18 brachial arterial anastomoses in dogs using silk sutures soaked in ^{32}P remained patent 4 to 6 weeks after operation, but so did 12 of 16 similar anastomoses using nonactive sutures. Similarly, all of the 19 longitudinal arteriotomies 6 cm in length that were closed with silk sutures soaked in ^{32}P remained patent as did all of 15 similar arteriotomies using nonactive silk sutures. The impregnation of vascular sutures (silk) and prosthetic grafts (teflon and dacron) with radiophosphorus by the method described did not improve the patency rate of small vessels following longitudinal arteriotomy or end-to-end anastomosis, or following replacement grafting. (TSS) (BBB)

34149 CONCENTRATION AND PURIFICATION OF HUMAN CHORIONIC SOMATO-MAMMOTROPIN (HCS) BY AFFINITY CHROMATOGRAPHY: APPLICATION TO RADIOIMMUNOASSAY. Weintraub, Bruce D. (National Insts. of Health, Bethesda, Md.). Biochem. Biophys. Res. Commun.; 39: 83-9(8 Apr 1970).

Columns of Sepharose-coupled antibody to HCS were used to purify labeled and unlabeled hormone by affinity chromatography prior to radioimmunoassay. The method permits concentration and 85 to 95% recovery of HCS from large volumes of biologic fluid or tissue extract, resulting in a five hundredfold increase in ultimate sensitivity for the hormone (2 μμg/ml). This has enabled demonstration of previously undetected HCS in plasma and tumor extracts of certain patients with bronchogenic carcinoma. (auth)

34150 STUDIES WITH ANTIBODES IN GASTRIN. RADIOIMMUNUNOASSAY IN HUMAN SERUM AND PHYSIOLOGICAL STUDIES. McGuigan, James E.; Trudeau, Walter L. (Washington Univ., St. Louis. John Cochran Veterans Administration Hospital, St. Louis. Univ. of Florida, Gainesville). Gastroenterology; 58: 139-50(Feb 1970).

A double antibody radioimmunoassay technique for measuring gastrin in human serum is described. The results of these studies indicate the requirement for inclusion of ethylenediaminetetraacetate in the immune incubation mixtures. In addition, heat inactivation of the serum prior to radioimmunoassay was required for authentic measurement of serum gastrin levels in human serum. Results of these studies indicate that the proteinase and peptidase inhibitor, Trasylol, which is required in the radioimmunoassay of glucagon, is not required for inclusion in this radioimmunoassay method for measurement of gastrin. Since heparin produced no systematic effects on immunoassayability of gastrin, gastrin levels were measured in serum rather than plasma. Under the conditions of elevated temperature utilized in these studies immunoreactivity of gastrin was found to be thermostable. Fasting serum gastrin levels in 14 normal young adult male volunteers were found to range from immeasurably low to 162 pg per ml with a mean value of 48 pg per ml (SD = 42 pg per ml). Increased levels of serum gastrin were detected and measured in response to stimulation of gastrin release using normal adult male volunteers by feeding a steak-containing meal, as well as following ingestion of glycin and sodium bicarbonate solutions. Elevations in serum gastrin levels in response to stimulation were observed in some, but not all, members of each experimental

group. When peak elevations of serum gastrin were detected they occurred from 30 to 45 min following application of the stimulus. Peak responses to stimulation range from 100 to 600 pg of gastrin per ml. Appropriately diluted sera from a patient with hypergastrinemia associated with the Zollinger–Ellison syndrome and hypergastrinemia in a normal adult male volunteer following ingestion of a steak-containing meal yielded radioimmunoassay calibration plots indistinguishable from radioimmunoassay plots derived using dilutions of authentic human gastrin I in fasting normal human serum. (auth)

34151 EFFECT OF ^{32}P CHROMIUM PHOSPHATE ON IMMUNE REACTIONS AND PHAGOCYTIC ACTIVITY IN RATS. Kinnaert, P.; Desmul, A.; Tagnon, A.; Toussaint, C. (Fondation Medicale Reine Elisabeth, Brussels. Univ. Libre, Brussels). Transplantation; 9: 457-62(May 1970).

Rats injected i.v. with 1 $\mu c/g$ of ^{32}P chromium phosphate showed a significant depression of their antibody synthesis against sheep red blood cells. The phagocytic activity was also reduced. The animals exhibited a marked reduction in circulating mononuclear cells. Skin graft rejection was unaffected. Lymphopenia alone is not a factor sufficient to prevent graft rejection. The possible mode of action of ^{32}P chromium phosphate on immune reactions is discussed. (auth)

34152 EXPERIMENTAL VACCINATION OF CALVES WITH IRRADIATED LARVAE OF OSTERTAGIA OSTERTAGI AND COOPERIA ONCOPHORA. Buerger, H.-J.; Pfeiffer, A. (Tierarztliche Hochschule, Hanover). Zentralbl. Veterinaermed., Reihe B; 16: 357-67(Jun 1969). (In German).

One group (group A) of ten Holstein Friesian calves was dosed twice, before pasturing, with 50,000 irradiated (40 kR) third-stage larvae each of Cooperia oncophora and Ostertagia ostertagi at an interval of four weeks. A second group (group B) of ten calves was treated with 50,000 irradiated larvae of C. oncophora only and four weeks later with 50,000 irradiated larvae of O. ostertagi. Ten calves (group C) remained as untreated control animals. The three groups (A, B, C) were then pastured in one group from May to October. The egg counts of the vaccinated calves (groups A and B) increased slightly after vaccination. The higher egg counts were related to lesser weight gains and softer feces at the beginning of the grazing season. During the grazing season the egg counts of these vaccinated calves rose typically but were lower than those of the control animals (group C) at the end of the grazing season and during the following winter. Animals of all three groups developed considerable gastroenteritis in August and September after having been heavily exposed to infective larvae in July. The weight gains of all three groups did not differ. The vaccination method described did not prevent parasitic gastroenteritis although it reduced the egg output. (auth)

34153 SUSCEPTIBILITY TO INFECTION WITH PASTEURELLA TULARENSIS AND THE IMMUNE RESPONSE OF MICE EXPOSED TO CONTINUOUS LOW DOSE RATE γ RADIATION. Hodge, F. A. (Oregon State Univ., Corvallis); Leif, W. R.; Silverman, M. S. J. Infect. Dis.; 120: 356-65(Sep 1969).

Mice were exposed to continuous low dose rate (1.4/R hr) γ radiation from a ^{60}Co source followed by subcutaneous injections with varying doses of the live vaccine strain (LVS) of Pasteurella tularensis. Immunized survivors were subsequently challenged 30 days later with an airborne infection of either the LVS strain or the virulent SCHU S-5 strain of P. tularensis. The mice accumulated total doses ranging from 1000 to 3000 R. Although the avirulent strain caused no effect in normal mice, a fulminating infection occurred in irradiated mice. As the total radiation dose increased, the susceptibility to infection increased, as indicated by a decrease in the LD_{50}. The attenuated LVS is virulent for mice when administered as an aerosol (in contrast to its avirulence when injected subcutaneously), but immune mice, both nonirradiated and irradiated, survived such an aerosol infection. Irradiated, immunized mice challenged with an aerosol of the virulent SCHU S-5 strain showed a decreased immunity, especially at the higher doses of radiation. Bacterial counts of the lungs, liver, spleen, and lymph nodes of nonimmunized mice exposed to a lethal aerosol dose of the avirulent LVS showed increasing numbers of bacteria. Immune animals, however, cleared the lungs 5 days after infection, with no involvement of the other tissues. Although continuous low dose rate irradiation does not produce overt illness, even at high total doses, any further insult, such as live bacterial vaccines, will result in serious illness. Should animals survive the immunization after the irradiation, some impairment of immunity may occur. (BBB)

34154 MORPHOLOGIC AND IMMUNOLOGIC CHANGES INDUCED IN THE LUNGS OF RATS BY LOCALIZED IRRADIATION. de Halleux, F. (Univ. of Louvain, Belgium). Strahlentherapie; 139: 196-202(Feb 1970).

Changes in rat lungs, following localized irradiation, were observed by roentgenologic, morphologic and immunologic techniques. In general, radiologic and morphologic alterations were in accordance with earlier reports. The prominence of secondary infectious processes is particularly noted. The antigenic pattern of rat lung remains unchanged shortly after irradiation. After several months, individual animals show a loss of one or two lung TSA's in the irradiated tissue. (auth)

34155 IMMUNOLOGY OF RADIOCHIMERAS. Duplan, J. F. (Institut du Radium, Paris). pp 197-254 of Actions Chimiques et Biologiques des Radiations. /Haissinsky, M. (ed.). Paris; Masson et Cie, Editeurs (1968). (In French).

A comprehensive review is presented of various aspects of immunity in isogenic, allogenic, and xenogenic transplants. The significance of irradiation in preventing undesirable immune reactions of the host following transplantation of foreign tissue is discussed with regard to primary and secondary reactions. Methods of obtaining radiochimeras and immune reactions of isogenic, allogenic, and xenogenic chimeras are reviewed. The immunology of isogenic radiochimeras is discussed with regard to reactions stimulated by soluble antigens and blood cells, reactions stimulated by transplantation antigens, role of the thymus in producing immune cells in radiochimeras, adoptive immunity, and anamnestic responses. Other topics reviewed are: response of allogenic and xenogenic radiochimeras to antigens other than transplantation, origin of immune cells and immunoglobulins, survival of radiochimeras, prevention and treatment of secondary disease, and tolerance in radiochimeras. (193 references). (H.L.W.)

34156 EFFECT OF IONIZING RADIATION COMBINED WITH OTHER TYPES OF RADIATION ON THE FORMATION OF IMMUNITY TO NEWCASTLE DISEASE. Likhachev, N. V.; Kreymer, Yu. Kh.; Kostin, I. G.; Shershunova, L. I.; Kharlamov, V. T. Dokl. Vses. Akad. Sel'skokhoz. Nauk; No. 9, 16-19(1969). (In Russian).

Irradiation of chicks with low doses of γ rays combined with infrared and ultraviolet rays after they were inoculated with the La Sota strain of virus resulted in the development of marked immunity in the animals. The survival rate among the irradiated chicks by the time they were 60 days old was 5.3% higher than among the control animals. It was 2.7, 1.3, and 4.6% higher after infrared, ultraviolet, and γ radiation alone, respectively. (JPRS)

34157 RECOVERY OF HAEMOLYSIN-FORMING CAPACITY OF THE IRRADIATED SPLEEN BY RE-POPULATION. Simic, M. M.; Petrovic, Milica Z. (Boris Kidric Inst. of Nuclear Sciences, Belgrade. Univ. of Belgrade). pp 21-30 of Radiation and the Control of Immune Response. Vienna; International Atomic Energy Agency (1968).

From Panel on Radiation and the Control of Immune Response, Paris, France. See STI/PUB-175; CONF-670669.

Results of investigation of repopulation of the spleen with immunologically competent cells are given. The rat spleen was irradiated immediately after an injection of sheep red cells, removed at various time intervals, and shielded while the animal underwent whole-body irradiation. Only repopulating progenitors were assayed. It was shown that the amount of hemolysin synthesized by the repopulated spleen increased from practically zero level to normal. The rate of the increase was not constant; it was slow for the first 3 hr, then abruptly increased. It was concluded that repopulating progenitors of hemolysin-forming cells immigrated rapidly following spleen irradiation and that those cells that immigrated into the spleen during the 4 to 5 hr following irradiation were sufficient to account for a total recovery of the spleen's hemolysin-forming capacity. The origin of the colonizing progenitors is briefly discussed. (C.O.)

34158 ACUTE SECONDARY DISEASES IN DOGS. Chertkov, J. L. (Central Inst. of Haematology and Blood Transfusion, Moscow). pp 51-8 of Radiation and the Control of Immune Response. Vienna; International Atomic Energy Agency (1968).

From Panel on Radiation and the Control of Immune Response, Paris, France. See STI/PUB-175; CONF-670669.

Cytological transformations that occur in the hematopoietic cell population of x-irradiated dogs during acute secondary disease are characterized. Studies made on dogs that received allogenic transplants of bone marrow stem cells and skin were included. It was pointed out that the cytological transformations observed were not seen in dogs that received autologous transfer of bone marrow stem cells and that hyperbasophilic cells were not seen if skin transplants were performed on dogs that had received autologous cells. It was concluded that this cytological transformation may be characteristic of the dog. (C.O.)

34159 CELLULAR AND HUMORAL EVENTS DURING HOMOGRAFT REACTION IN DIFFUSION CHAMBERS. Capalbo, E. E.

(Comision Nacional de Energia Atomica, Buenos Aires). pp 59-75 of Radiation and the Control of Immune Response. Vienna; International Atomic Energy Agency (1968).

From Panel on Radiation and the Control of Immune Response, Paris, France. See STI/PUB-175; CONF-670669.

Using single- and double-compartment diffusion chambers implanted in x-irradiated mice, studies were performed on homograft reaction by mouse spleen cells differing at the H-2 locus. Target cells were destroyed and probably functionally inhibited (anti-rat response) when cultured in contact with killer cells or separated from them by a porous membrane. However, killer cells proliferate at a higher rate than non-stimulated cells as was seen in the immune response. Evidence is reported on primary sensitization of competent spleen cells against homologous cells without mediating cell-to-cell contact. (auth)

34160 ROLE OF THE THYMUS IN THE RECOVERY OF THE IMMUNE SYSTEM OF RADIATION CHIMERAS. Doria, G. (CNEN-EURATOM, Rome). pp 77-84 of Radiation and the Control of Immune Response. Vienna; International Atomic Energy Agency (1968).

From Panel on Radiation and the Control of Immune Response, Paris, France. See STI/PUB-175; CONF-670669.

The thymus of x-irradiated recipient mice acts on donor potentially competent cells by triggering the differentiation of the precursors of antigen-sensitive cells. Thymus-induced antigen sensitive cells were found distributed in the spleen and lymph nodes, but not in the bone marrow. (auth)

34161 MYELOFIBROSIS IN IRRADIATED RATS AFTER BONE-MARROW TRANSFUSION: AN IMMUNOLOGICAL REJECTION PHENOMENON? Fliedner, T. M.; Becker, H.; Cronkite, E. P.; Messner, H. (Inst. for Haematology, Freiburg i. B.). pp 85-9 of Radiation and the Control of Immune Response. Vienna; International Atomic Energy Agency (1968).

From Panel on Radiation and the Control of Immune Response, Paris, France. See STI/PUB-175; CONF-670669.

Preliminary observations indicated that the development of myelofibrosis in rats might be a consequence of allogenic marrow transplants into irradiated recipients. The incidence of myelofibrosis in bone-marrow transfused recipients appeared to be particularly high between day 15 and 40 when 33% of all animals studied showed definite signs of myelofibrosis. The microscopic evaluation of myelofibrosis in the rats examined is described and the etiology is discussed. It was concluded that myelofibrosis was definitely observed under the given experimental conditions and that the diseases were associated with whole-body x irradiation and subsequent bone marrow transplants. (C.O.)

34162 RECENT ADVANCES IN RADIATION IMMUNOLOGY. Bibb, W. R. (Atomic Energy Commission, Washington, D. C.). pp 91-9 of Radiation and the Control of Immune Response. Vienna; International Atomic Energy Agency (1968).

From Panel on Radiation and the Control of Immune Response, Paris, France. See STI/PUB-175; CONF-670669.

The research efforts of the United States Atomic Energy Commission directed toward a better understanding of the processes involved and the roles played by the immunological and reticuloendothelial systems in radiation injury are briefly reviewed. Those research projects directed toward diagnostic and therapeutic uses of radiolabeled antibodies for cancer, tissue and organ transplantation, and basic studies of the immunological system (cellular events during the development of immune competence) are included in the review. Six studies were summarized to indicate the scope of the AEC program. (C.O.)

34163 IMMUNOLOGICAL EFFECTS OF IONIZING RADIATIONS. Costachel, O.; Corneci, I.; Andrian, T.; Sandru, Gh. (Inst. of Oncology, Bucharest). pp 115-22 of Radiation and the Control of Immune Response. Vienna; International Atomic Energy Agency (1968). (In French).

From Panel on Radiation and the Control of Immune Response, Paris, France. See STI/PUB-175; CONF-670669.

Studies were made of the rejection of non-irradiated allogeneic grafts and of irradiated autogeneic and syngeneic grafts. Two types of grafts, free and pediculate, were used in the experiments. When free grafts were given 3000 R x radiation in vitro and transplanted to mice, no rejection occurred during the first 30 days. A dose of 4000 R resulted in 25% rejection, and a dose of 7000 R resulted in 100% rejection. The rejected grafts were edematous, cyanotic, necrotic, and ulcerated. Rats were used for experiments on pediculate, autogeneic grafts. Following a 5000 R dose of x radiation a hard dermatitis was observed. Microscopic examination revealed inflammatory reactions. Forty-eight hrs after transplantation a vascular neoformation appeared at the periphery and penetrated to the interior. A cellular infiltration around the graft consisted of polymorphonuclear leukocytes, lymphocytes, monocytes, and fibrocytes. A discussion is presented of the significance of the rejection of irradiated grafts in immunological phenomena. (H.L.W.)

34164 GROWTH OF HAEMOPOIETIC SPLEEN COLONIES AFTER GRAFTING OF HUMAN BONE MARROW IN MICE. Louwagie, A. C.; Verwilghen, R. L. (Academisch Ziekenhius St. Raphael, Louvain, Belg.). Nature (London); 225: 383(24 Jan 1970).

A study is reported in which the aim was to induce growth of human haemopoietic tissue in mice that had received lethal body irradiation. Anti-human antilymphocytic serum (ALS) was administered after cell grafting to counteract the graft versus host reaction. The irradiation dose was 975 R from a Maxitron (GEC) operating at 250 kV and 25 mA, with a dose rate of 30.4 R/min. Human bone marrow cells were grafted within 3 hr. of irradiation. Surviving animals were killed on day 10 and the peripheral blood was sampled and examined for a dimorphic red cell population; an Rh-agglutination test was also performed in vitro. There was no improvement in the 10-day survival of the bone marrow and ALS-treated recipients. No spleen colonies could be demonstrated in ungrafted irradiated and ALS or human serum treated irradiated animals. None of the irradiated and bone marrow grafted mice that did not receive ALS survived 10 days after irradiation. Of 42 bone-marrow grafted, ALS-treated irradiated animals 16 were surviving at day 10, and in 13 animals haemopoietic colonies were observed at the spleen surface. Histological examination of the spleen colonies showed precursor and mature cells of the three main haemopoietic cell lines, and a dimorphic red cell picture was found in the peripheral blood. The Rh agglutination test was positive. Circumstantial evidence was obtained that the haemopoietic colonies were derived from human bone marrow. (UK)

34165 ALLOGENEIC TRANSPLANTS USING ^{60}Co-IRRADIATED TEETH IN MONKEYS. Nordenram, Ake (Univ., Bergen); Bergman, Gunnar. Oral Surg., Oral Med., Oral Pathol.; 29: 944-9(Jun 1970).

Allotransplantations of thirty-two premolars were performed in the upper jaws of eight adult monkeys. Before transplantation, sixteen teeth were irradiated with ^{60}Co γ. No differences could be detected with respect to tissue reactions when irradiated and non-irradiated teeth were compared. More or less serious changes occurred in both groups. Gamma irradiation in doses of between 40,000 and 500,000 R was obviously not sufficient for suppression of immune reactions following allotransplantation of teeth. (C.H.)

34166 RESISTANCE PRODUCED IN MICE AND RATS BY INOCULATION WITH IRRADIATED TRYPANOSOMA RHODESIENSE. Duxbury, R. E.; Sadun, E. H. (Walter Reed Army Medical Center, Washington, D. C.). J. Parasitol.; 55: 859-65(Aug 1969).

An investigation was undertaken of the effect of ionizing radiation on the reproduction and survival of the African trypanosome, and of the extent to which the resulting attenuated parasites could produce protective immunity in mice and rats. Parasites exposed to doses of ^{60}Co γ irradiation from 10,000 to 1,000,000 R were inoculated into mice and rats. Mice inoculated with nonirradiated trypanosomes developed progressive infections and died 3 to 5 days after inoculation. Conversely, all those inoculated with trypanosomes that had been irradiated at doses of more than 20,000 R survived. Complete protection from a challenging infection was induced in mice given 2 or 3 immunizing inoculations. A few animals that had received a single immunizing inoculation died after challenge. Similar results were obtained in rats. Fifty-four per cent of the rats that had received a single immunizing inoculation, 85% of those with 2 immunizing inoculations, and 97% of those with 3 immunizing inoculations survived challenge with nonirradiated trypanosomes. Fluorescent antibody tests in immunized rats indicated development of antibodies following inoculation with irradiated trypanosomes. All but 1 of 24 rats survived a second challenge inoculation given 1, 3, or 5 months after the first challenge, but only 1 of 16 rats survived rechallenge after 7 months. (BBB)

34167 HOST-PARASITE RELATION OF PARAMPHISTOMUM MICROBOTHRIUM FISCHOEDER, 1901, IN EXPERIMENTALLY INFESTED RUMINANTS, WITH PARTICULAR REFERENCE TO SHEEP. Horak, Ivan Gerard (Veterinary Research Inst., Onderstepoort, South Africa). Onderstepoort J. Vet. Res.; 34: 451-540(Dec 1967).

Metacercariae of the conical fluke, responsible for paramphistomiasis of sheep and cattle, were x irradiated with doses of 1, 2, 4, or 8 kR. Their infectivity and immunogenicity in sheep were determined. The pathologic anatomy, clinical pathology, and symptoms of acute paramphistomiasis are described in detail and their inter-relations are discussed. The viability and fertility of P. microbothrium were adversely affected by irradiation of 2 to

8 kR. It was found, in attempts to establish a suitable level of irradiation that could be used in the development of a vaccine, that 1 kR was too low and 4 and 8 kR too high. Irradiation with 2 kR seemed to be optimal. Not only was the pathogenicity of the infestation reduced because of the decreased percentage take after 21 days, but the number of worms still remaining may be sufficient to stimulate the development of resistance to reinfestation. Experiments were performed in which normal and irradiated metacercariae were used to produce immunity in the hosts. Adult cattle and sheep were successfully immunized by repeated doses of small numbers of metacercariae (500 to 1500). Adult cattle were readily immunized either with single doses of 40,000 to 176,000 unirradiated metacercariae or with single or divided doses of 40,000 x-irradiated metacercariae. Although adult sheep could be immunized, this was only completely successful with a single or divided dose of 40,000 metacercariae. Immunization of adult goats was successful with a single or divided dose of 40,000 metacercariae. (BBB)

34168 PRELIMINARY STUDIES ON THE ANTIGENICITY OF IRRADIATED AND NONIRRADIATED PERIPHERAL NERVE. Marmor, Leonard; Liebes, Dorothy (Univ. of California, Los Angeles). Clin. Orthop.; 65: 235-8(Jul-Aug 1969).

Following a single injection containing extract of irradiated or nonirradiated human or dog peripheral nerve emulsified with Freund's complete adjuvant, rabbits produced precipitating antibodies as detected by gel diffusion. The antisera gave strong reactions with extracts of human or dog nerve, regardless of which peripheral nerve or individual dog within the species was used. There appeared to be no pronounced antigenic difference in response of the nerve to irradiation. Human antisera did not react with dog nerve or nerves from other species. Irradiated dog-nerve antisera, however, produced a reaction of partial identity with human nerve which could be removed by absorption with normal human serum, thus leaving intact the reaction to dog nerve. Absorptions with homologous normal serum suggest that the peripheral nerve contains substances which may originate principally from the serum. (auth)

34169 SPLEEN COLONY FORMATION IN RADIATION CHIMERAS TREATED WITH ALLOPURINOL AND AMPICILLIN. Bortin, M. M.; Sternberg, R. J.; Rimm, A. A. (Mt. Sinai Hospital, Milwaukee. Marquette School of Medicine, Inc., Milwaukee). Rev. Fr. Etud. Clin. Biol.; 14: 773-5(Oct 1969).

The effect of allopurinol and/or ampicillin on hematopoietic stem cell colonization of the spleen following syngeneic or allogenic bone marrow transplantation was studied in lethally x irradiated mice. Spleen colony formation was not depressed by drug administration. (auth)

34170 INFLUENCE OF IMMUNOLOGICAL ACTIONS UPON THE RADIOSENSITIVITY OF INOCULATED TUMOR PC-1. Akhtyamov, M. G.; Ayapbergenov, E. K.; Kenesarina, A. A. (Inst. of Oncology and Radiology, Alma-Ata, USSR). Tr. Kaz. Nauch.-Issled. Inst. Onkol. Radiol.; 6: 167-73(1969). (In Russian).

Suspensions of irradiated (2,000, 6,000 R) tumor cells were transplanted to rats; the transplants were then given a 2,000 R radiation dose. The mitotic index and the average number of cells in a microscope field were used as indicators of increased radiosensitivity in homotransplants. In the case of autotransplants the increased radiosensitivity was indicated by volume and weight measurements and by morphological characteristics of the tumor. (auth)

34171 THE METABOLISM OF DIFFERENT IMMUNOGLOBULIN CLASSES IN IRRADIATED MICE. III. EFFECTS OF SUPRA-LETHAL DOSES OF X-RAYS. Bazin, H.; Doria, G. (Center for Nuclear Studies, Casaccia, Italy). Int. J. Radiat. Biol.; 17: 359-65(1970).

The serum level of IgM, IgA, IgG_1, and IgG_2 was studied in mice exposed to 1000–5000 R of x rays. The serum concentration of all classes was found to decrease during the first 72 hours after irradiation. At 72 hours after 2000–5000 R, the percentage of the initial value range from 53 to 70 for IgM, from 24 to 44 for IgA, from 63 to 70 for IgG_1, and from 55 to 71 for IgG_2. If several mechanisms may account for the decrease of each Ig class, the more pronounced fall of the serum level of IgA can clearly be related to the radiation induced lesions of the intestinal mucosa. (auth) (UK)

34172 RADIOIMMUNOLOGICAL SYSTEM FOR THE DETERMINATION OF THE ANTIDIURETIC HORMONE. Menard, Joel; Milliez, Paul (Hopital Broussais, Paris). Compt. Rend., Ser. D; 270: 1053-6(16 Feb 1970). (In French).

Antilysine 8 Vasopressin antibodies were obtained in rabbits by repeated injections of the hormone (haptene) coupled with human serum-albumin. They allow the technique of Yalow and Berson to be applied to the antidiuretic hormone. Lysine 8 Vasopressin was labeled with iodine-131 and purified on "Amberlite CG 50." The radioimmunological measurement system separates the free hormone and the hormone linked to the antibodies by carbon coated with Dextran. Quantities of Argenine 8 Vasopressin or Lysine 8 Vasopressin of 1.25 $\mu\mu$g to 120 $\mu\mu$g can be measured in this way with great accuracy. (France)

34173 GAMMA-IRRADIATED VENEZUELAN EQUINE ENCEPHALITIS VACCINES. Reitman, Morton; Tribble, H. R. Jr.; Green, Leonard (Dept. of the Army, Fort Detrick, Frederick, Md.). Appl. Microbiol.; 19: 763-7(May 1970).

The efficacy of Formalin-activated Venezuelan equine encephalitis (VEE) vaccine has been reported to be low for man. Although a live VEE vaccine has been shown to be highly effective for the protection of laboratory workers, local and systemic reactions have occurred in approximately 20% of inoculated individuals. Therefore, studies were initiated in an attempt to produce an inactivated vaccine of high potency with low toxicity. Inactivated VEE vaccines were prepared by exposing virus suspensions to 8×10^6 or 10×10^6 R of γ radiation. Irradiated VEE vaccines prepared from virus suspensions produced in Maitland-type chick embryo (MTCE) cell cultures and in monolayer cultures of human diploid strain WI-38 cells were highly immunogenic for mice and guinea pigs. Guinea pigs vaccinated with a series of three inoculations of vaccine (MTCE) survived challenge with at least $10^{5.4}$ mouse intracerebral 50% lethal doses of VEE virus. Irradiated vaccines induced high levels of serum-neutralizing and hemagglutinin-inhibiting antibodies in guinea pigs and rabbits. These findings suggest that ionizing radiation may be effective in the preparation of an inactivated VEE vaccine. (auth)

34174 CELLS INVOLVED IN THE IMMUNE RESPONSE. XVIII. POTENTIAL HEMOLYSIN-FORMING CELLS IN THE SACCULUS ROTUNDUS OF THE NORMAL ADULT RABBIT. Abdou, Nabih I.; Richter, Maxwell (Royal Victoria Hospital, Montreal). J. Immunol.; 104: 1087-93(May 1970).

Antibody-forming cells (AFC) directed toward antigens on the sheep red blood cell have been localized to the sacculus rotundus of the normal unimmunized adult rabbit. These cells are either potential AFC or direct precursors of the AFC. The normal rabbit sacculus does not possess antigen-reactive cells (ARC) directed toward this or any other antigen. Only the rabbit bone marrow possesses the ARC. The significance of this finding with respect to accepted criteria for the definition of the primary immune response, both in vivo and in vitro is discussed. (auth)

34175 IMMUNOSUPPRESSIVE EFFECT OF THE DEPLETION OF CIRCULATING LYMPHOCYTES BY CHRONIC IRRADIATION OF THE RAT SPLEEN. Yoshida, Takeshi; Hunter, Robert L.; Benacerraf, Baruj (National Inst. of Health, Bethesda, Md.). J. Immunol.; 104: 1111-16(May 1970).

The effect of chronic irradiation of the spleen with a ^{32}P polyethylene strip applied to the lateral surface of the spleen on the blood level of circulating small lymphocytes and on the immune response to 2,4-dinitrophenyl-bovine γ globulin administered in complete Freund's adjuvant was investigated in the rat. Irradiation restricted to the spleen caused severe lymphopenia and significantly depressed the cellular and humoral immune response to this antigen. (auth)

34176 RECOVERY OF IMMUNE RESPONSIVENESS IN LETHALLY-IRRADIATED MICE PROTECTED WITH SYNGENEIC MARROW CELLS. Gregory, Connie J.; Lajtha, L. G. (Holt Radium Inst., Manchester Eng.). Int. J. Radiat. Biol.; 17: 117-226(1970).

Recovery of antibody-forming capacity in the spleen of lethally irradiated mice protected with 10^6 syngeneic marrow cells has been examined in terms of the recovery of antibody-forming cells (PFC) responsiveness to Srbc and its sensitivity to thymus cell influence, and secondly in terms of the recovery of focus-forming capacity. PFC responsiveness was not detected for almost 2 weeks after irradiation and grafting. This was followed by a biphasic recovery pattern. Both PFC and focus-forming capacity increased rapidly during the next 1 to 2 weeks and then subsequently much more slowly. Injection of 50×10^6 normal thymus cells into mice at the time of immunization resulted in an apparent hastening of the recovery of PFC responsiveness. The possibility that the observed recovery pattern reflects an impaired production of thymus-derived antigen-reactive cells is discussed. (auth) (UK)

34177 STUDIES ON THE LOCAL IMMUNITY OF INTESTINAL TRACT OF CHICKENS AFTER ORAL ADMINISTRATION OF NEWCASTLE DISEASE VIRUS. Kono, Reisaku; Akao, Yoriyuki; Sasagawa, Akira; Nomura, Yoshitoshi (National Inst. of Health,

Tokyo. Nippon Inst. for Biological Science, Tokyo). Jap. J. Med. Sci. Biol.; 22: 235-52(Aug 1969).

An enterotropic avirulent Newcastle disease virus (NDV-Ishii) which was administered by the oral route in a dose of about 10^5 to 10^8 TCD_{50}/chick caused alimentary tract infection in 4 week old chickens, which excreted NDV-Ishii in feces from 3 to 7 days after the first feeding. Indirect fluorescent antibody microphotograph of sections of the small intestine revealed that a sort of surface infection was established by the oral administration of enterotropic NDV. But the virus was scarcely recovered from feces after the second feeding 4 to 6 weeks later and the neutralizing activity of fecal extracts, probably coproantibody, was demonstrated a few weeks after the virus feeding. Bursectomy plus γ ray irradiation (650 R) after hatching exerted a profound influence on humoral immunity, namely, suppression of HI antibody production in serum, and at the same time the development of local immunity of the alimentary tract was disturbed. Those chickens excreted the virus even after its second administration. On the other hand, thymectomy plus γ ray irradiation alone had no suppressive effect on establishment of the alimentary tract resistance to reinfection. Therefore it is concluded that the local immunity of the alimentary tract of chickens against refeeding of the enterotropic NDV depends largely on humoral immunity governed by the bursa-dependent lymphoid system, and probably on IgA antibody which is produced locally by lymphoid cells of the lamina propria. (auth)

Ecology

Refer also to abstracts 34028, 34305, 34310–34313, 34322, 34366, and 34370.

34178 (BMI–171-125) STUDIES OF THE AVIFAUNA ON AMCHITKA ISLAND, ALASKA. Annual Progress Report, June 1968–July 1969. Amchitka Bioenvironmental Program. Williamson, Francis S. L.; Emison, William B. (Smithsonian Institution, Edgewater, Md. Chesapeake Bay Center for Environmental Studies). Contract AT(26-1)-171. 77p. Dep. CFSTI.

For Battelle Memorial Inst., Columbus, Ohio.

Field and laboratory studies of the birds of Amchitka Island are reported. A list of the species present during the study period was compiled. The population density of the birds present was measured by either direct counts or extrapolation from sample counts. Data were collected on the ecological and geographical distribution of birds, and the feeding ecology of selected species (emphasizing those used as food by man and those representative of the available spectrum of feeding niches) was studied. Analyses were made of stomach contents and determinations of body burdens of radionuclides were carried out in selected species. A general analysis of the disturbance of habitats that might influence the population density and/or distribution of birds was also made. The objective of these studies is sufficient knowledge of the avian ecology to predict the effects of nuclear tests on the bird populations, determine whether the tests might produce unacceptable hazards to the biota, the environment, and man, and provide pretest data for assessing the effects of the tests. (C.O.)

34179 (BNWL–1050(Pt.1)) PACIFIC NORTHWEST LABORATORY ANNUAL REPORT FOR 1968 TO THE USAEC DIVISION OF BIOLOGY AND MEDICINE. VOLUME I. LIFE SCIENCES. PART 1. BIOLOGICAL SCIENCES. Thompson, R. C.; Stack, Marguerite S.; Swezea, Evelyn G. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Jan 1970. Contract AT(45-1)-1830. 230p. Dep. CFSTI.

Separate abstracts were prepared on 21 sections of this report. Other sections report the results of studies on the physiology of experimental animals. (C.H.)

For abstracts of individual sections see: 33988, 34017, 34180, 34181, 34295–34301, and 34610–34619.

34180 (BNWL–1050(Pt.1), pp 6,37-42) THE RESPONSE OF JUVENILE SALMONIDS TO ACUTE THERMAL SHOCK. Dean, J. M. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

From Pacific Northwest Laboratory annual report for 1968 to the USAEC Division of Biology and Medicine. Vol. I. Life sciences. Pt. 1. Biological sciences.

Juvenile salmonids (Oncorhynchus kisutch and Oncorhyncus tshawytscha) were acclimated at different temperatures and were tested for their response to high-temperature exposures. The temperature of acclimation and the rate of exposure had marked effects on the response of the fishes to acute thermal exposure. (auth)

34181 (BNWL–1050(Pt.1), pp 6,43-5) ALTERATIONS IN HEPATOCYTE FUNCTION OF THERMALLY ACCLIMATED RAINBOW TROUT (SALMO GAIRDNERI). Dean, J. M.; Berlin, J. D. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

From Pacific Northwest Laboratory annual report for 1968 to the USAEC Division of Biology and Medicine. Vol. I. Life sciences. Pt. 1. Biological sciences.

There was an increased level of leucine incorporation into protein in hepatocytes from cold-acclimated fish (Salmo gairdneri) as compared to warm-acclimated fish. The results suggest that there is a decreased rate of secretion of plasma protein from the hepatocytes of cold-acclimated fish. (auth)

34182 (CONF–690335, pp 9-12) FEDERAL-STATE COOPERATION IN THE CONTROL OF RADIATION, PAST AND PRESENT. Wilson, E. Frank (Arkansas Dept. of Health, Little Rock. Div. of Radiological Health).

Radiation protection programs in the U.S.A. are discussed, with emphasis on the role of State and Federal government. It is pointed out that Public Law 90-602 (Oct. 1968) sets up the legal mechanism for Federal–State cooperation in protection of the population against non-ionizing radiations. (C.H.)

34183 (CONF–690335, pp 26-33) SURVEILLANCE IN PERSPECTIVE. Weaver, Charles L. (Bureau of Radiological Health, Rockville, Md.).

The fallout monitoring activities of both the State and Federal health agencies in the U.S.A. are reviewed with emphasis on activities of the Bureau of Radiological Health. The future potential for environmental radiation exposure of human populations in relation to industrial uses of nuclear energy is discussed. (C.H.)

34184 (CONF–690335, pp 34-8) ROLE OF STATES AND REGIONAL OFFICES IN THE CONTROL OF RADIATION. Hansen, Chris A. (Bureau of Radiological Health, Rockville, Md.).

The role of State health agencies, regional offices of the Public Health Service, and the Federal Environmental Control Administration in the development of programs for radiation protection of human populations, as well as other environmental control programs, is discussed. The implications of legislation enacted in 1968 (Public Law 90-602) which authorizes the Secretary of Health, Education, and Welfare to establish and administer standards for the performance of all sources of non-ionizing radiation are considered. (C.H.)

34185 (CONF–690335, pp 57-71) PANEL: IMPLEMENTATION OF PUBLIC LAW 90-602. Elder, R. L.; McMartin, H. L.; Snow, D. L.; Nelson, D. J. Jr.; Neill, R. H. (Bureau of Radiological Health, Rockville, Md.).

The implementation and administration of Public Law 90-602 are discussed with emphasis on provisions for cooperation between State and Federal agencies in establishing performance standards ensuring the safety of electronic equipment in regard to the emission of non-ionizing radiations that may have an adverse effect on public health. Implications of the law in regard to the responsibility of manufacturers of electronic equipment are considered. The need for standards covering protection against lasers and microwaves is discussed. The current status of a program to ensure the safety of diagnostic x-ray equipment is reviewed. (C.H.)

34186 (COO–1733-9) STUDY OF UNSUPPORTED ^{210}Po FOR ION EXCHANGE IN SOILS AND UPTAKE IN VEGETATION. Third Technical Progress Report, August 15, 1969–May 1, 1970. Watters, R. L.; Johnson, J. E. (Colorado State Univ., Fort Collins. Dept. of Radiology and Radiation Biology). 14 May 1970. Contract AT(11-1)-1733. 79p. Dep. CFSTI.

Mechanisms involved in the translocation of ^{210}Po from soil to edible plants were studied for various soil types and conditions. The natural ^{210}Po content of 11 topsoils and seven profiles found in the U.S.A. and Puerto Rico was determined. Results indicated that soil type influences the ^{210}Po content. The effects of rainfall on the uptake of ^{210}Po by agricultural plants from various soil types were investigated in greenhouse studies. (C.H.)

34187 (COO–1733-10) STUDY OF UNSUPPORTED ^{210}Po FOR ION EXCHANGE ION SOILS AND UPTAKE IN VEGETATION. Summary Report for the Three Year Period, 1967–1970. Watters, R. L.; Johnson, J. E. (Colorado State Univ., Fort Collins. Dept. of Radiology and Radiation Biology). 14 May 1970. Contract AT(11-1)-1733. 63p. Dep. CFSTI.

The translocation of ^{210}Po from soil to edible plants was studied for various soil types and conditions. The equilibrium distribution coefficient (K_d) was determined for 608 samples, 408 soil samples were analyzed for natural ^{210}Po content, 1,200 control plant samples were analyzed for natural ^{210}Po content, and 1,570 plant samples were studied for ^{210}Po uptake from soil. From the soil data the range of K_d was determined for ^{210}Po in 18 agricultural soils

and the change in distribution of ^{210}Po between soil and soil solution as a function of soil pH and silt content was studied. An experiment to determine the movement of ^{210}Po in a watershed revealed very little movement to the potable water supply. Dialyses and electrophoresis studies showed that $^{210}PoO_2$ solution/suspensions are markedly changed in the soil and soil solution environment. The transfer coefficients which express the concentration ratio of ^{210}Po in vegetation to ^{210}Po in soil at harvest time are of sufficient magnitude to indicate that a radiological health hazard from ingestion could occur to limited populations if megacurie quantities were dispersed in agricultural areas. Foliar absorption studies showed measurable absorption from small contaminated spots which could be significant if the contamination were spread over the whole plant. Paper chromatography studies of plant extracts indicated at least one species of polonium which may be organically bound, or at least is not typical of the $^{210}PoO_2$ control solution. (auth)

34188 (NIRS-RSD-24) RADIOACTIVITY SURVEY DATA IN JAPAN, NUMBER 24. (National Inst. of Radiological Sciences, Chiba (Japan)). Aug 1969. 15p. Dep. CFSTI (U. S. Sales Only).

Data are presented on contents of ^{137}Cs and ^{90}Sr in milk, powdered milk, vegetables, tea, and total diet during 1968 and 1969. Tables are presented to show values for various localities in Japan. (H.L.W.)

34189 (SWRHL-80-r) MANAGEMENT HISTORY OF THE AEC BEEF HERD, 1 JUNE 1964-1 JUNE 1969. Smith, Donald D. (Public Health Service, Las Vegas, Nev. Southwestern Radiological Health Lab.). Mar 1970. 29p. Dep. CFSTI.

From June 1, 1964 to June 1, 1969, the Atomic Energy Commission's (AEC) beef herd has been maintained on the Nevada Test Site (NTS) by the Public Health Service's Southwestern Radiological Health Laboratory (SWRHL). The herd is used to determine the uptake and retention of various radionuclides and to provide background information regarding various inquiries and possible legal claims from off-site ranchers. The history, animal husbandry, production, and sampling program for the herd during the last five years are reviewed. Data are presented on the content of various radioisotopes in selected tissue samples and their relation to plant species ingested during grazing. (C.H.)

34190 FRESHWATER ECOLOGICAL STUDIES IN PANAMA AND COLOMBIA. Templeton, W. L.; Dean, J. M.; Watson, D. G.; Rancitelli, L. A. (Battelle Memorial Inst., Richland, Wash.). Contract AT(26-1)-171. Bioscience; 19: 804-8(Sep 1969).

Ecology studies conducted in eastern Panama and northwest Colombia were designed to acquire the necessary data for evaluation and prediction of the potential radiation dose to the indigenous populations in the proposed regions for nuclear excavations of a sea-level canal. The underwater environment study in the areas plays an important part in the life of the indigenous populations, as the areas of settlement are predominantly on the riverine systems that supply water for drinking, cooking, washing, and constitute the sewage and waste systems. Of major importance to this program is the source of protein in the form of fish, reptiles, and macroinvertebrates. In all areas with reasonable access to the sea, it was interesting to note that marine food organisms are preferred to freshwater organisms despite the presence of the latter in all areas. For predictive purposes, it was estimated that about 100 g of aquatic food organisms and 4 l of river water per day would be the most conservative values. Despite the lack of extensive ichthyological information for the area, which is one of the least studied although extremely rich in freshwater fauna, collections from scattered ecologically diverse areas and preliminary identifications were made that should contribute to the zoogeography and ecology of the continent. Collections were made at 19 stations in Panama and 15 stations in Colombia with provisional identifications of 121 species. Samples of water, suspended solids, sediments, and selected biological tissues were analyzed for Na, K, Ca, Mg, Sr, P, Fe, Mn, Cr, Zn, and Cu by flame emission spectroscopy, absorption spectrophotometry, and colorimetric technique, and by neutron activation for Na, Co, Ag, Cs, Zn, Sc, Sb, Hg, W, Au, Rb, K, Br, Se, and Cr. Selected samples were also analyzed for fallout and naturally occurring radionuclides. (BBB)

34191 CRITERIA AND LEVELS OF ACTION IN THE FIELD OF RADIOLOGICAL SAFETY MEASURES. Prat, G.; Frossard, H.; Arnaud, G. Rev. Corps Sante Armees; 10: 43-9(Feb 1969). (In French).

Radiation exposure of the population as a result of nuclear weapons tests and warfare and the potential exposure due to incidents at nuclear installations are discussed. The various means by which radioactive products can reach the human body are classified according to origin of the radiation (nuclear tests incident, radioactive waste leakage), dispersion in the atmosphere, waste and soil, means of entry into the food chain (vegetable and animal contamination), and the various parameters that determine the degree of contamination. A number of criteria for various levels of contamination, action in case of an incident, and subsequent curative measures are discussed. A preconceived emergency plan is stressed which would take into account both predictable parameters and unforeseeable events. Such a contingency plan could be studied on the basis of the most serious envisaged accident or from the point of view of one whose consequences would be most extensive. (TSS) (BBB)

34192 CONCENTRATIONS OF ^{137}Cs IN RAINWATER AND MILK IN AUSTRALIA DURING 1968. Bonnyman, J.; Duggleby, J. C.; Molina-Ramos, J.; Patterson, I. C. (Commonwealth X-Ray and Radium Lab., Melbourne). Aust. J. Sci.; 32: 244-8 (Dec 1969).

Tabulations are presented of routine monitoring of ^{137}Cs in Australian rainwater and milk on a yearly basis from inception to 1968, and on a monthly basis for 1968, at representative centers throughout Australia. The average ^{137}Cs concentrations in rainfall in 1968 were lower than in 1967, and much lower than in any year since experiments began in 1964. The average annual concentration of ^{137}Cs in milk in 1968, for all sampling stations, was lower than in the previous year by an average of 25%, and lower than in any year since sampling began in 1963. The higher concentrations of ^{137}Cs in milk, in Western Australian sampling centers were due to uptake from the soil. (Australia)

34193 ^{90}Sr AND ^{137}Cs IN TOTAL DIET SAMPLES: A COMPARATIVE STUDY OF DATA. Roecklein, P. D.; Smedley, C. E.; Simpson, R. E. (Bureau of Science, Food, and Drug Administration, Washington, D. C.). Radiol. Health Data Rep.; 11: 47-64 (Feb 1970).

Six federal, state, and private organizations have published values for ^{90}Sr and ^{137}Co activities in total diet samples for the period, January 1961 through December 1967. The data reported by these organizations have been statistically compared to determine how well the values of the several agencies agree. Our results show that there is agreement (at a significance level equal to 0.05) in about 60 percent of the cases for comparable samples collected at about the same location and time and analyzed by similar methods. The 40 percent disagreement may be caused by differences in samples, however, the specific sampling sites within a geographical area cannot be verified. (auth)

34194 DATA. SECTION I. MILK AND FOOD. Radiol. Health Data Rep.; 11: 141-51(Mar 1970).

Data are presented on the content of ^{137}Cs, ^{131}I, and ^{90}Sr in samples of milk collected at various locations throughout the U.S.A. from Dec. 1968 through Nov. 1969. (C.H.)

34195 DATA. SECTION II. WATER. Radiol. Health Data Rep.; 11: 153-5(Mar 1970).

Data are presented on gross α and β activity in samples of surface water, treated water, and ground water collected at various locations throughout Florida during 1968. (C.H.)

34196 TRITIUM CONCENTRATIONS IN FOOD, 1967-1968. Moghissi, A. A. (Southwestern Radiological Health Lab., Las Vegas, Nev.); Lyon, R. J. Radiol. Health Data Rep.; 11: 233-6(May 1970).

Tritium concentrations were determined in food samples obtained from several children's homes throughout the United States. The average concentrations of tritium in food indicate a decreasing trend from 1967 to 1968. The average dose equivalent from tritium in food was calculated to be 0.08 mrem for 1967 and 0.03 mrem for 1968. (auth)

34197 TRITIUM BODY BURDEN OF CHILDREN, 1967-1968. Moghissi, A. A. (Southwestern Radiological Health Lab., Las Vegas, Nev.); Lieberman, Robert. Radiol. Health Data Rep.; 11: 227-31(May 1970).

The tritium concentration in body water of children was determined from samples of urine taken from two children in each of nine Institutional Total Diet Sampling Stations located throughout the U.S.A. The tritium concentrations in body water of children gradually decreased from about 1.5 nCi/liter to less than 0.2 nCi/liter during the period, January 1967 to December 1968. Several anomalies were noted. The dose equivalent from tritium for standard man was calculated to be 0.15 mrem for 1967 and 0.13 mrem for 1968. The dose equivalent for children varies according to age and is roughly 0.1 mrem for a 13-year old child. (auth)

34198 ENVIRONMENTAL LEVELS OF RADIOACTIVITY IN UTAH FOLLOWING OPERATION PINSTRIPE. Pendleton, R. C.; Lloyd, R. D. (Univ. of Utah, Salt Lake City). Radiol. Health Data Rep.; 11: 65-7(Feb 1970).

Samples of green vegetation, tanzy mustard (Sophia pinnata) and Kentucky bluegrass (Poa pratensis), collected in Utah along the fallout trajectory on the fourth day following the venting of an underground nuclear detonation at the Nevada Test Site on April 25, 1966, were analyzed for γ-emitting radionuclides at periods of three days, two months, and six months following collection. The radionuclides found included ^{137}Cs, ^{131}I, ^{54}Mn, ^{103}Ru, ^{106}Ru, and ^{95}Zr. These represented the spectrum of fresh fission products. Levels of radionuclides found in samples of desert shrubs collected just prior to the detonation represented the spectrum of characteristic of old fallout. The width of the fallout track was surveyed using a scintillation detector and a β-γ survey meter. Dairy cattle in the selected sampling area were not grazing during this period of time and no increase in ^{137}Cs, ^{131}I, or ^{90}Sr in milk was noted. (C.H.)

34199 DATA. SECTION II. WATER. Radiol. Health Data Rep.; 11: 82-4(Feb 1970).

Data are presented on gross α and β activity in water supplies sampled at a number of locations in Alaska during 1968 and 1969. (C.H.)

34200 DATA. SECTION I. MILK AND FOOD. Radiol. Health Data Rep.; 11: 69-81(Feb 1970).

Data are presented on the content of ^{137}Cs, ^{131}I, and ^{90}Sr in samples of milk collected throughout the U.S.A., Canada, Central and South America during 1968 and 1969. The content of ^{137}Cs, ^{89}Sr, and ^{90}Sr in the standard diet of young adult males in the U.S.A. during 1969 was also measured. (C.H.)

34201 DATA. SECTION II. WATER. Radiol. Health Data Rep.; 11: 25-7(Jan 1970).

Data are presented on the gross α and β radioactivity in raw and treated water supplies of selected locations in the U.S.A. during 1969. (C.H.)

34202 DATA. SECTION I. MILK AND FOOD. Radiol. Health Data Rep.; 11: 11-21(Jan 1970).

Data are presented on the content of ^{137}Cs, ^{131}I, ^{89}Sr, and ^{90}Sr in samples of milk collected at various locations throughout the U.S.A. between October 1968 and October 1969. (C.H.)

34203 EFFECTS OF POLLUTION ON THE STRUCTURE AND PHYSIOLOGY OF ECOSYSTEMS. Woodwell, G. M. (Brookhaven National Lab., Upton, N. Y.). Science; 168: 429-33(24 Apr 1970).

A brief review is presented of changes in the structure and function of ecosystems resulting from the accumulation of various toxic substances in the biosphere. The significance of pollution in the food chain is discussed and it is emphasized that toxic substances, chiefly radioisotopes, that are mutagenic are of greater hazard to man than to other organisms. A controlled experiment on the ecological effects of radiation was conducted at Brookhaven National Laboratory. An oak-pine forest was exposed to chronic irradiation from a ^{137}Cs source for six months. The effect was a systematic dissection of the forest. Trees were eliminated at low exposures, then the taller shrubs, then the herbs, and finally the lichens and mosses. Another experiment on chronic irradiation of herb communities in old fields showed that the herb field was more resistant to radiation than the forest. The similarity of radiation damage to that of fire in forests is discussed. It is pointed out that the species surviving high radiation-exposure rates are the ones commonly found in disturbed places, such as roadsides, gravel banks, and areas with nutrient-deficient or unstable soil. Studies at the Savannah River Laboratory showed that the grass stage of the long leaf pine was more resistant to radiation damage than the mature trees. A study of the effects of sulfur oxides released from smelting in Ontario revealed a striking reduction in the number of species of higher plants along a gradient of 62 kilometers. It was estimated that the damage was equivalent to that produced by exposure to 40 R/day. A discussion is given of possible mechanisms involved in the changes in patterns in terrestrial ecosystems resulting from pollution. Changes are away from the forest toward hardy shrubs and herbs; away from diversity in birds, plants, and fish toward monotony; and away from stability toward instability especially with regard to sizes of populations of small, rapidly reproducing organisms such as insects and rodents. The contribution of thermal pollution from reactors to degradation of ecosystems is pointed out, and the importance of increasing restrictions on technology is emphasized. (H.L.W.)

34204 PROCEEDINGS OF THE SEMINAR ON MARINE RADIOECOLOGY, CHERBOURG, FRANCE, 3rd-6th DECEMBER 1968. Paris; European Nuclear Energy Agency (1969). 150p. (CONF-681225).

Separate abstracts were prepared for the 26 papers presented at the conference. (H.L.W.)

For abstracts of individual papers see: 34205–34229, and 34607.

34205 MARINE ECOLOGY AND NUCLEAR ENERGY. Jammet, Henri (CEA, Fountenay-aux-Roses, France). pp 13-18 of Proceedings of the Seminar on Marine Radioecology. Paris; European Nuclear Energy Agency (1969).

See CONF-681225.

A survey of health physics problems involved in the use of atomic energy showed that nuclear reactors and atomic factories produce radioactive wastes, practically all of which are stored under such rigorous safety conditions that it is virtually impossible for them to be dispersed in the environment. Under normal operating conditions, nuclear reactors release only minute quantities of radioactive products into the air or the sea, whereas atomic factories discharge larger quantities of fission products into inland bodies of water or the sea. Nuclear incidents may entail pollution of either the air or the sea by fission products from reactors. Hazards to man from marine pollution stem from radioactive substances carried by the sea water or deposited on the sea bottom and along the coast line. Radioactive substances passing into sea water and then into food chains may ultimately result in contamination of food eaten by man. Marine life may be affected by radioactivity from exposure to external radiation from seawater or sediments, and radioactive contamination of living organisms may occur as a result of transfer of radioactivity through various levels of the food chain. Discharge of effluents into the sea involves problems such as the initial dispersion of the radioactive substances, chemical and physical dilution of such substances in the marine environment, and concentration in the biological species composing the food chains. (H.L.W.)

34206 RADIOECOLOGICAL FIELD STUDIES CARRIED OUT IN THE FEDERAL REPUBLIC OF GERMANY. Feldt, W. (Bundesforschungsanstalt fuer Fischerei, Hamburg). pp 21-4 of Proceedings of the Seminar on Marine Radioecology. Paris; European Nuclear Energy Agency (1969).

See CONF-681225.

Investigations conducted by the German Hydrographic Institute between 1961 and 1965 on water from the Barents Sea showed that contamination values of ^{137}Cs and ^{90}Sr were doubled by the Russian bomb tests. Contamination of Atlantic water was 0.1 to 0.2 pCi/l for ^{90}Sr and 0.2 to 0.3 pCi for ^{137}Cs. In the North Sea German Bight 0.8 pCi/l and ^{90}Sr and 0.93 pCi/l ^{137}Cs were found. In 1965 the Federal Board of Fisheries made a survey of surface water from the North Sea area. The level of ^{90}Sr ranged between 0.4 and 0.8 pCi/l. The level of ^{137}Cs was 1.4 times that of ^{90}Sr. Fish of this area were also analyzed. During cruises of the research vessel in the spring of 1966 and the autumn of 1968 water and organisms from different layers of the Atlantic were analyzed for ^{137}Cs and ^{90}Sr. (H.L.W.)

34207 RADIOECOLOGICAL FIELD STUDIES CARRIED OUT IN SPAIN. Ros, J. (Oceanographic Lab., San Pedro del Pinatar, Spain). pp 25-6 of Proceedings of the Seminar on Marine Radioecology. Paris; European Nuclear Energy Agency (1969).

See CONF-681225.

Studies at the Junta de Energia Nuclear in Madrid included a comparison of natural α and β contamination levels with higher levels resulting from construction of power reactors or from discharge of radioactive waste, the role of food chain organisms in transfer of radioactivity, and measurement of α and β activity in organisms of the Mediterranean Sea and the Mar Menor. Plans for future radioecological studies are discussed. (H.L.W.)

34208 RADIOECOLOGICAL FIELD STUDIES CARRIED OUT IN FRANCE. Bovard, P. (CEA, Fontenay-aux-Roses, France). pp 27-32 of Proceedings of the Seminar on Marine Radioecology. Paris; European Nuclear Energy Agency (1969).

See CONF-681225.

Field studies were carried out on parameters likely to influence transport and dispersion of radioisotopes. For studies on diffusion, release of waste was simulated using water marked with Rhodamine B. Studies on the dynamics of sedimentation and the role of spray dispersion in air-sea transfer were also conducted. Fauna and flora inventories of the Cherbourg peninsula were taken; estimates of biomasses and observations of their fluctuation with time under natural conditions of climate and season were made. Investigations on socio-economic conditions were conducted. Studies on radioactivity transport processes showed that the role of the physicochemical form of radioisotopes in sea water was significant. It was discovered that soluble organic complexes of ruthenium in the form of colloidal hydroxide were formed. It was found that thioglycolic complexes composed anionic species were very slowly adsorbed on particles in contrast to the very fast adsorption of colloidal hydroxides. It was found that particulate forms of ruthenium

were the main contaminating agents of algae and invertebrates. (H.L.W.)

34209 COMPARATIVE RESEARCH ON RADIOACTIVE CONTAMINATION OF THE MARINE ENVIRONMENT AND FRESH WATER. Ervet, P.; Remy, M. L.; Gahinet, M. E.; Moroni, J. P. (Central Service for Protection against Ionizing Radiations, Le Vesinet, France). pp 33-41 of Proceedings of the Seminar on Marine Radioecology. Paris; European Nuclear Energy Agency (1969).

See CONF-681225.

Data obtained for the marine environment were compared with those for inland waters and freshwater fish by the Central Service for Protection against Ionizing Radiations. Results of radiation monitoring of seawater during 1965 to 1968 near the La Hague nuclear establishment are presented for ^{137}Cs and ^{90}Sr. Fish from the Atlantic, the English channel, and the Mediterranean Sea were analyzed for ^{137}Cs, ^{226}Ra, ^{90}Sr, and uranium. Studies on fresh water included analysis of the Loire, Rhone, and Seine rivers during 1967 for ^{137}Cs and ^{90}Sr; results are tabulated. It was found that the concentration of ^{137}Cs in freshwater fish was 20 to 100 times that of marine fish. Freshwater fish were also analyzed for ^{226}Ra and natural uranium. It is suggested that the high content of inorganic elements in the marine environment is an important factor in protection against radioactive contamination. The importance of monitoring freshwater fish from water polluted by the mining of radioactive materials or by nuclear installations is emphasized. (H.L.W.)

34210 RADIOACTIVITY STUDY IN MARINE ENVIRONMENT. Schreiber, B. (Parma Univ., Italy). pp 43-50 of Proceedings of the Seminar on Marine Radioecology. Paris; European Nuclear Energy Agency (1969).

See CONF-681225.

Samples of seawater, plankton, and sediment were collected from the Ligurian Sea and the North Adriatic Sea and analyzed for radioactivity. Concentration factor values for ^{90}Sr contamination in seawater and plankton were calculated for the period 1961 to 1968. The values were ten times higher in the Ligurian plankton than in the Adriatic; this appears to be related to the presence of Acantharia (Protozoa) that contain $SrSO_4$ in the Ligurian Sea. Plankton and seawater were analyzed for ^{144}Ce, ^{155}Eu, ^{42}K, ^{54}Mn, ^{147}Pm, ^{226}Ra, ^{125}Sb, ^{90}Sr, and ^{95}Zr and gross beta activity during 1961 to 1968. The values increased to a maximum in 1963 and then decreased to 1968. Distribution of radioisotopes in various layers of sediments was analyzed; results were obtained ^{144}Ce, ^{137}Cs, ^{155}Eu, ^{147}Pm, ^{125}Sb, ^{90}Sr, and radioisotopes of K, Ra, T and U. (H.L.W.)

34211 BACTERIAL AND RADIOACTIVE POLLUTION. Paoletti, A. (Univ., Naples). pp 51-2 of Proceedings of the Seminar on Marine Radioecology. Paris; European Nuclear Energy Agency (1969).

See CONF-681225.

The role of algae, bacteria, and fungi in the cycling of radioisotopes in seawater was studied. Bacteria were labeled with ^{32}P for studies on filter feeding activities of molluscs and crustaceans. It was concluded that the radioisotopes are fixed rapidly by autotrophic microorganisms (particularly by algae), and that from these they pass through the food chain into larger organisms including man. It was possible to locate and select predatory organisms in the marine environment by using artificially labeled microorganisms. The importance of predatory organisms, especially the filter feeders, in autopurification of water was revealed by the use of labeled microorganisms. (H.L.W.)

34212 STUDIES CARRIED OUT AT THE LABORATORIO PER LO STUDIO DELLA CONTAMINAZIONE RADIOATTIVA DEL MARE, CNEN-EURATOM. Bernhard, M. (CNEN, Piascherino, La Spezia, Italy). pp 53-7 of Proceedings of the Seminar on Marine Radioecology. Paris; European Nuclear Energy Agency (1969).

See CONF-681225.

A program for the study of factors influencing uptake, accumulation, and loss of radioisotopes by marine organisms is outlined. The program is composed of two parts, as follows: survey of environmental elements and factors in a sampling area; and experiments on the influence of environmental factors on the uptake, accumulation, and loss of radioisotopes by marine organisms in relation to data obtained in the survey. (H.L.W.)

34213 RADIOECOLOGICAL STUDIES CARRIED OUT AT THE LABORATORIO DI RADIOPROTEZIONE, C.A.M.E.N., ITALY. pp 59 of Proceedings of the Seminar on Marine Radioecology. Paris; European Nuclear Energy Agency (1969).

See CONF-681225.

A study was made of the radioactivity resulting from fallout in sediments, plankton, and mussels. Specific studies were carried out on the uptake of ^{85}Sr and ^{91}Y by Ulva lactuca and the uptake of ^{90}Sr by Mytilus galloprovincialis. (H.L.W.)

34214 STUDIES CARRIED OUT IN THE UNITED STATES IN THE FIELD OF MARINE RADIOECOLOGY. Osterberg, C. (Atomic Energy Commission, Washington, D. C.). pp 61 of Proceedings of the Seminar on Marine Radioecology. Paris; European Nuclear Energy Agency (1969).

See CONF-681225.

Most of the research on marine radioecology in the United States is supported by the Atomic Energy Commission, although some research is supported by the National Institute of Health and the National Science Foundation. Some of the largest projects are being carried out at the Woods Hole Oceanographic Institute and the Scripps Institution of Oceanography. Research on the fate of nuclear wastes in the Columbia River and in the Northeast Pacific Ocean is being carried out at the University of Washington, Oregon State University, Battelle-Northwest, the Bureau of Commercial Fisheries, the Oregon Fish Commission, and the U. S. Zoological Survey. (H.L.W.)

34215 SPECIFIC ACTIVITY CONCEPT AND HAZARDS PREDICTION. Lowman, F. G. (Atomic Energy Commission, Puerto Rico). pp 63-5 of Proceedings of the Seminar on Marine Radioecology. Paris; European Nuclear Energy Agency (1969).

See CONF-681225.

Methods of predicting hazards to man through radioactive contamination of food supplies of marine origin are discussed. The degree of hazard may be predicted on the basis of maximum permissible concentration of radioisotopes in drinking water and food or on the basis of the maximum permissible specific activities of the radioisotopes in the critical organs of man. The MPSA approach is based upon the progressive dilution of radioisotopes by the corresponding stable elements with which the isotopes are mixed as they move from the source through the environment to man. Limitations of the MPC method are pointed out, and methods for application of the MPSA method are described. (H.L.W.)

34216 SUMMARY OF FIELD STUDIES IN THE UNITED KINGDOM. Jefferies, D. F.; Preston, A. (Fisheries Radiobiological Lab., Lowestoft, Eng.). pp 67-71 of Proceedings of the Seminar on Marine Radioecology. Paris; European Nuclear Energy Agency (1969).

See CONF-681225.

Field studies were carried out by the United Kingdom Atomic Energy Authority on the major fission product radioisotopes, ^{106}Ru, ^{144}Ce, ^{95}Zr, ^{95}Nb, ^{137}Cs, and ^{90}Sr, discharged to the northeast Irish Sea from the fuel reprocessing plant at Windscale. Studies were conducted on basic processes of dilution and dispersion, accumulative potential of the biota for selected elements, and the relation to food webs and seasonal effects. The dispersion of radioisotopes in the Blackwater Estuary was studied by measuring their content in oysters and examination of the relationship between distance and concentration for the various radioisotopes. A comparison was made of the distribution of stable and radioactive zinc of power station origin. The biological half-life of ^{65}Zn in oysters was measured. A study was made of the distribution of ^{137}Cs and ^{90}Sr in water surrounding the British Isles. The ^{137}Cs content of fish from various sea areas was studied. The Ministry of Agriculture, Fisheries and Food conducted field studies on effluent discharges at several sites. Radioecological data were obtained for ^{65}Zn, ^{60}Co, ^{55}Fe, ^{110m}Ag, ^{32}P, and ^{35}S. (H.L.W.)

34217 SUMMARY OF RESEARCH CARRIED OUT IN SWEDEN. Hanners, L. O. G. (National Water Protection Service, Drottningholm, Sweden). pp 73-4 of Proceedings of the Seminar on Marine Radioecology. Paris; European Nuclear Energy Agency (1969).

See CONF-681225.

Studies were conducted on factors regulating the accumulation of ^{137}Cs in fish in the Baltic Sea and in Swedish lakes. In some species there was an increased concentration of ^{137}Cs with increasing size of fish. The concentration in lake fish was found to be 1.6 to 4.1 times higher than that in fish from the Baltic Sea; this was explained by differences in potassium concentration of the water. Effects of feeding habits on accumulation of ^{137}Cs in white fish were studied. Studies were conducted on pike from different localities to determine effects of potassium and salinity of water on ^{137}Cs concentration. Samples of water, fish, and seaweed were analyzed for ^{51}Cr, ^{54}Mn, ^{55}Fe, ^{59}Fe, ^{60}Co, ^{58}Co, ^{64}Cu, and ^{65}Zn. It was found that dilution of radioactive wastes from nuclear power plants reduced the concentration to harmless levels. (H.L.W.)

34218 SUMMARY OF WORK PERFORMED AT AKTIEBOLAGET ATOMENERGI. Agnedal, P. O. (Aktiebolaget Atomenergi, Studsvik, Sweden). pp 75 of Proceedings of the Seminar on Marine Radioecology. Paris; European Nuclear Energy Agency (1969).

See CONF-681225.

The concentrations of stable cobalt and zinc in water and fish from four locations in the Baltic and from one on the Swedish west coast were investigated. The seasonal variation of plankton and water was followed for more than two years in one location. The investigation was undertaken in order to study variation in these elements in the same fish species from different locations and differences between species from the same locality. The results showed an increase in the zinc content in the water with increasing salinity, whereas the cobalt concentration did not show regular variation. The zinc concentration in the fish species was of the same order of magnitude in the muscle and bone in all species and showed only small differences with regard to locality. The cobalt concentration in fish tissues varied more from place to place. The determinations were performed with neutron activation analysis which gave good accuracy and made it possible to determine very low concentrations. (H.L.W.)

34219 MARINE RADIOECOLOGICAL STUDIES IN JAPAN. Saiki, M. (National Inst. of Radiological Science, Tokyo). pp 77-84 of Proceedings of the Seminar on Marine Radioecology. Paris; European Nuclear Energy Agency (1969).

See CONF-681225.

Radiation monitoring of the marine environment of Japan revealed that ^{55}Fe and ^{65}Zn played an important role in radioactive contamination of marine organisms. A tuna examined in 1956 from the Bikini Atoll following the Pacific nuclear explosion tests contained ^{55}Fe, ^{115m}Cd, ^{90}Sr, ^{65}Zn, ^{54}Mn, ^{140}Ba, and ^{140}La. Fish collected from the Sea of Japan and Japanese lakes and rivers during 1963 to 1966 were analyzed for ^{137}Cs and ^{90}Sr; results are tabulated. To obtain information on the concentration of radionuclides from sea water to marine biota, quantitative studies on trace elements in sea water and marine biota are being investigated by atomic absorption spectrometry and activation analysis. Ratios of ^{137}Cs/^{90}Sr and ^{144}Ce/^{90}Sr in coastal sediment and sea water were determined during 1964 to 1965 and results are tabulated. (H.L.W.)

34220 SUMMARY OF WORK PERFORMED AT AKTIEBOLAGET ATOMENERGI. Agnedal, P. O. (Aktiebolaget Atomenergi, Studsvik, Sweden). pp 87-8 of Proceedings of the Seminar on Marine Radioecology. Paris; European Nuclear Energy Agency (1969).

See CONF-681225.

Studies on the uptake and metabolism of ^{60}Co were conducted on marine, freshwater, and brackish water fish. Results indicated that there were differences between these types of fish. Investigations on the uptake of ^{60}Co and ^{65}Zn by fish (Esox lucius), seaweed (Fucus vesiculosus), crustaceans (Gammarus sp.), and molluscs (Macoma baltica, Mytilus edulis) were carried out. The accumulation factor for ^{65}Zn in fish was about 600 which is about the same as that for stable Zn. The accumulation factor for ^{60}Co was 30 to 40 which is in agreement with results for stable Co. (H.L.W.)

34221 STUDIES CARRIED OUT IN BELGIUM IN THE FIELD OF MARINE RADIOACOLOGY. Van der Borght, O. (Nuclear Research Centre, Mol, Belg.). pp 89-90 of Proceedings of the Seminar on Marine Radioecology. Paris; European Nuclear Energy Agency (1969).

See CONF-681225.

Marine fish were monitored for ^{137}Cs and ^{90}Sr as part of the routine monitoring of the food chain during 1966 to 1969. Rhodamine and radioactive bromine were used as indicators in studies on dilution and movement of water masses near the mouth of the Escaut river. The accumulation of ^{106}Ru in marine organisms (Fuens, Mytilus, Nucella, Littorina) was measured for studies on mechanisms leading to contamination of the environment. It was found that temperature influenced the accumulation of ^{106}Ru during the first two days of the experiments. The highest contamination was found in the younger parts of the shell and of the byssus. (H.L.W.)

34222 LABORATORY EXPERIMENTS ON THE UPTAKE OF ^{60}Co AND ^{65}Zn BY MARINE COASTAL ORGANISMS. van Weers, A. W. (Reactor Centrum Nederland, Petten, Netherlands). pp 91 of Proceedings of the Seminar on Marine Radioecology. Paris; European Nuclear Energy Agency (1969).

See CONF-681225.

Research was conducted at the Petten Reactor Center on the disposal capacity for various radionuclides in the North Sea coastal area. Results are reported on the uptake and release of ^{60}Co and ^{65}Zn by marine organisms. The mean concentration factors measured after eight days uptake by Mytilus were respectively 25 for ^{60}Co and 85 for ^{65}Zn. After one day's uptake by Fucus, the concentration factors for ^{60}Co varied between 90 and 150 (mean 120) and 160 and 380 (mean 230) for ^{65}Zn. The concentration factor for ^{60}Co uptake by mussels and for ^{65}Zn and ^{60}Co uptake by Fucus is relatively insensitive to carrier addition. Chelation of both ^{65}Zn and ^{60}Co remarkably reduced the concentration factor. Release of ^{60}Co after eight days was slow. Cobalt-60 appeared to be mainly localized in the liver of the mussel and fairly high levels were also found in structures assumed to be kidney. Zinc-65 was found mainly in the kidney and to a much lesser extent in the liver. (H.L.W.)

34223 EXPERIMENTAL STUDIES IN CONTAINED ENVIRONMENTS. Ancellin, J. (Commissariat a l'Energie Atomique, La Hague, France). pp 93-7 of Proceedings of the Seminar on Marine Radioecology. Paris; European Nuclear Energy Agency (1969).

See CONF-681225.

Laboratory experiments were conducted on the role of marine organisms in the transport and distribution of radioisotopes in the marine environment. Studies on factors influencing the mechanisms of contamination were also conducted. Laboratory procedures for experimental contamination are described. Concentration factors of ^{144}Ce, ^{137}Cs, and ^{106}Ru for algae, invertebrates, and fish were determined and results are tabulated. Data show marked differences from field measurements in contaminated natural environments. Experiments on contamination from diet showed that the ^{106}Ru activity was two or three times that produced by contamination from the environment. Ruthenium-106 was used for studies on effects of physical and chemical properties of radioisotopes on the contamination of marine organisms. (H.L.W.)

34224 SUMMARY OF EXPERIMENTAL STUDIES IN THE UNITED KINGDOM. Bryan, G. W. (Marine Biological Assoc. Lab., Plymouth, Eng.). pp 99-102 of Proceedings of the Seminar on Marine Radioecology. Paris; European Nuclear Energy Agency (1969).

See CONF-681225.

Experimental studies were conducted on radioisotopes arising from the discharge of fission products into the sea as a result of fuel reprocessing and from the discharge of neutron-activation products from nuclear power stations. Concentrations of Cs and Sr were surveyed in the Irish Sea in order to determine concentration factors to be expected for the fission products ^{137}Cs and ^{90}Sr. Neutron-induced nuclides of trace elements essential to marine organisms were studied in relation to the behavior of stable elements. Experiments were conducted on absorption and loss of ^{137}Cs in the fish, Pleuronectes and Raia, and absorption and loss of ^{131}I, ^{239}Pu, ^{106}Ru, ^{90}Sr, ^{95}Zr, and ^{95}Nb in the lobster, Homarus. The metabolism of Zn and ^{65}Zn was examined in oysters, scallops (Chlamys), lobsters, seaweeds (Laminaria), and diatoms (Phaeodactylum). Other nuclides such as ^{54}Mn and ^{57}Co were used in studies on Homarus and ^{59}Fe was studied in Mytilus and Phaeodactylum. The chemistry of Fe and ^{59}Fe in sea water was studied in relation to adhesion of particulate Fe to the surface and phytoplankton. (H.L.W.)

34225 MARINE RADIOECOLOGICAL STUDIES IN JAPAN. Saiki, M. (National Inst. of Radiological Sciences, Tokyo). pp 103-8 of Proceedings of the Seminar on Marine Radioecology. Paris; European Nuclear Energy Agency (1969).

See CONF-681225.

Marine bacteria and yeasts were used in laboratory studies on uptake of ^{137}Cs, ^{85}Sr, ^{90}Y, ^{106}Ru, ^{60}Co, ^{65}Zn, and ^{32}P. Concentration factors of ^{65}Zn, ^{32}P, ^{51}Cr, ^{60}Co, ^{131}I, and ^{137}Cs were determined for phytoplankton, green and red algae, and diatoms. The uptake of RuCl and Ru nitrosyl complex into clams was investigated. Concentration factors of ^{90}Sr were determined for fish tissues, whole fish, and clam muscle tissue. Stable element analysis was used for determining concentration factors of ^{90}Sr in mollusc shells and in green, brown, and red algae. Studies were conducted on physico-chemical behavior of radioisotopes in seawater; enrichment of radioisotopes in food; assessment of human internal exposure by surveys on consumption of marine products, determining content of radioisotopes in food, stable element content of food and human tissues, and determining correlation between whole-body counting data and bioassay data on samples such as blood and urine; assessment of human external exposure; and development of monitoring methods. (H.L.W.)

34226 MONITORING OF FISH FROM NORWEGIAN FISHING AREAS. Berge, G. (Inst. of Marine Research, Bergen). pp 109-12 of Proceedings of the Seminar on Marine Radioecology. Paris; European Nuclear Energy Agency (1969).

See CONF-681225.

Determinations of total β activity in fish and fish meal were made during 1961 to 1968. The contamination was estimated as the difference between total β activity and ^{40}K β activity. Measurements of ^{90}Sr in cod and haddock revealed only traces in these fish. Gamma spectrographic analyses revealed ^{54}Mn, ^{65}Zn, ^{106}Ru, and ^{137}Cs as contributors to the contamination of the fish. Levels in fish meal were always lower in total β activity. A significantly higher contamination was found in fish living on the sea bed. (H.L.W.)

34227 IAEA ACTIVITIES IN MARINE RADIOECOLOGY. Keckes, S. (International Lab. of Marine Radioactivity, Monaco). pp 113-17 of Proceedings of the Seminar on Marine Radioecology. Paris; European Nuclear Energy Agency (1969).

See CONF-681225.

An outline is presented of activities of the Agency towards promoting the goal of preventing pollution of the sea by radioactive materials in amounts which would adversely affect man. These activities include preparation of bibliographies and manuals, endorsing research in national laboratories, and coordinating research in national laboratories in the field of marine radioactivity through a Research Agreement Coordinated Program. Specific problems being studied are: diffusion of radionuclides by dynamic processes; concentration and physico-chemical forms of various elements and their radioisotopes; interaction of sea-bed and suspended sediments with radioisotopes; and accumulation and transfer of radioisotopes by biota. A report on the role of euphausids in the vertical transport of radionuclides is presented. Concentration ratios and loss of ^{144}Ce, ^{59}Fe, ^{106}Ru, and ^{65}Zn after 12 hrs exposure to seawater containing radioisotopes are tabulated. (H.L.W.)

34228 SUMMARY OF THE UNITED KINGDOM STUDIES ON EFFECTS OF RADIATION ON MARINE ORGANISMS. Woodhead, D. S. (Fisheries Radiobiological Lab., Lowestoft, Eng.). pp 125-6 of Proceedings of the Seminar on Marine Radioecology. Paris; European Nuclear Energy Agency (1969).

See CONF-681225.

Studies were conducted on reconcentration of radioactivity in eggs of marine organisms, particularly those of fish. Studies on eggs of fish included effects of acute and chronic radiation on egg mortality, determination of reconcentration factor for various isotopes, and calculation of dose rate to the developing embryo using a theoretical model. Data on radioactivity of the seabed were used for calculation of dose rates to benthic organisms. Research was begun on evidence for chromosome damage in benthic organisms from the contaminated area at Windscale and the effects of continuous low-level irradiation on the tropical fish, Lebistes reticulatus. (H.L.W.)

34229 EXPERIMENTAL WORK IN FRANCE ON THE EFFECTS OF IONIZING RADIATION ON MARINE ORGANISMS. Avargues, M. (CEA, Fontenay-aux-Roses, France). pp 127-9 of Proceedings of the Seminar on Marine Radioecology. Paris; European Nuclear Energy Agency (1969).

See CONF-681225.

Data were collected for evaluation of permissible levels of radioactive waste in effluents from the La Hague plant. Research projects on possible effects of radiation on marine life include: determination of the LD/50 for several species of animals; effects of γ radiation on gametogenesis and fertility; radiation effects on the hatching rate of fertilized eggs; teratogenic effects of radiation on fertilized eggs; radioinduced chromosome aberrations; effects of environmental factors such as temperature, light, and salinity on radiosensitivity; radiation effects on endocrine glands; radiation effects on growth and hematopoiesis; and genetic effects of radiation on animal species of a well-defined phenotype. (H.L.W.)

34230 OXYGEN CONSUMPTION, AMBIENT TEMPERATURE, AND EXCRETION OF ^{32}P IN COTTON RATS. Wagner, C. Kenyon (Univ. of Georgia, Athens). Contract AT(38-1)-310. Ecology; 51: 311-17(1970).

One of the major difficulties in evaluating energy flow in natural animal populations is the determination of field metabolism. Various writers have suggested that there may be a correlation between excretion rate of a radioactive isotope and metabolism in small mammals which might be used to determine metabolism in free-ranging animals. To test this hypothesis, cotton rats confined in the laboratory and in field enclosures were injected with ^{32}P and their excretion rates were measured. Oxygen consumption also was measured in the laboratory animals. A poor correlation was found between oxygen consumption and excretion rate in the laboratory while a significant correlation was found between ^{32}P excretion rate, oxygen consumption, and temperature. Assuming that this correlation held true in the field, oxygen consumption was predicted in the field population, as 2.37 cc $O_2/g\ hr^{-1}$ in July, 3.41 cc $O_2/g\ hr^{-1}$ in September, and 4.02 cc $O_2/g\ hr^{-1}$ in November. Oxygen consumption in the field was not significantly higher than in the laboratory, indicating that the cotton rats did not expend a significantly greater amount of energy in the field. The use of the excretion rate of a radioactive element as a predictor of metabolism was criticized because of the high variance and lack of correlation between excretion rate and metabolism at the individual level. (auth)

34231 SLOW ACCUMULATION AND TRANSFER OF RADIOSTRONTIUM BY YOUNG LOBLOLLY PINES (PINUS TAEDA L.). Dayton, Bruce R. (Univ. of North Carolina, Chapel Hill). Contract AT(40-1)-3299. Ecology; 51: 204-16(1970).

Stems of seven young loblolly pines on the Savannah River Plant Reservation, South Carolina, were each inoculated with 3.28×10^3 μCi of ^{90}Sr. Accumulation of ^{90}Sr in foliage continued for 13 months after inoculation, when a maximum of 1.27×10^3 μCi/tree was attained. Radiostrontium concentration was consistently higher in lower crown foliage than in upper crown foliage, and higher in second-year needles than new needles. There was little evidence of basipetal translocation of radiostrontium to roots. About 2% of the maximum foliage burden of radiostrontium was released by leaching during the 16 months following inoculation. Radioactivity of rainwater falling through crowns was best correlated with needle radioactivity, but was also inversely correlated with intensity of precipitation. Transfer of leached radiostrontium to the ground by rainwater flowing down stems was only 23% of that transferred by rainwater falling through tree crowns. Twenty per cent of the maximum foliar uptake was released by needles falling from the trees. The inoculated pines accumulated three times more radiostrontium in foliage than they released by needle fall and leaching. After 16 months 94% of the radiostrontium released from the inoculated trees was in litter and only 4.6% in mineral soil. Radiostrontium transferred to soil was generally confined to the top 2.5 cm where feeder roots are most abundant, but less than 10% of the radionuclide accumulated in soil was in roots. Accumulation in soil and roots closely approximated input from needle fall and foliar leaching, indicating that there was negligible input of basipetally translocated radiostrontium and negligible output due to leaching to subsoil, runoff, blowing away of litter, or recycling. The radiostrontium burden of a pine forest might be reduced considerably by removal of litter after contaminated needles have fallen. (auth)

34232 GEOCHEMICAL ECOLOGY OF MICROORGANISMS UNDER CONDITIONS OF DIFFERENT URANIUM CONTENT IN MUD DEPOSITS. Letunova, S. V.; Koval'skii, V. V.; Romanova, S. N. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Obshch. Biol.; 31: 111-20(Jan-Feb 1970). (In Russian).

Most strains of microorganisms isolated from the mud deposits rich in uranium—$1.5 \cdot 10^{-2}$% (the Issyk-Kul Lake) are capable of growth under higher concentrations of this element if compared with the strains isolated from the muds with a low content of uranium—$5.0 \cdot 10^{-5}$% (a pond in the Moscow district). Microorganisms with a different degree of adaptation to high uranium concentrations inhabit the same mud deposits. Physiological heterogeneity of the population is a base of natural selection. Large amounts of uranium are accumulated in the mud microorganisms, this process depending on ecological peculiarities and systematic position of the organisms. In the strains of microorganisms from the Issyk-Kul Lake adapted to a high content of uranium in muds, the accumulation of uranium in cells is accompanied by an acceleration of growth. Moscow strains adapted to a low content of uranium in the environment are characterized by a delayed growth under higher concentrations of this element in cells. (auth)

34233 ABSORPTION OF ^{137}Cs BY MUSCA DOMESTICA AND CONSEQUENT ENVIRONMENTAL CONTAMINATION. Bergamini, P. G.; Palmas, G.; Piantelli, F.; Rigato, M. (Univ., Siena, Italy). Health Phys.; 18: 491-8(May 1970).

Musca domestica was tagged at each stage of development—larva, pupa and imago—by means of three solutions of ^{137}Cs of different concentrations. Specific activity was studied throughout the organisms' life-cycle and into the ensuing generation. At each determination of specific activity, the concentration factor was studied in relation to the contaminated matter. The biological half-life of ^{137}Cs is calculated. The degree of contamination transmitted to the exposed surfaces by the contaminated organisms was also studied. (auth) (UK)

34234 ^{137}Cs CONCENTRATIONS IN ESKIMOS, SPRING 1968. Eckert, J. A.; Coogan, J. S.; Mikkelsen, R. L.; Lem, P. N. (Bureau of Radiological Health, Las Vegas, Nev.). Radiol. Health Data Rep.; 11: 219-25(May 1970).

To determine ^{137}Cs concentrations, 996 residents of 11 Alaskan villages were whole-body counted during April 1968. The methods of counting and selection of villages were chosen to complement the spring 1967 counts made by Rechen et al. The villages counted in this study were: Ambler, Anaktuvuk Pass Village, Egegik, Kiana, Mekoryuk, Noatak, Noorvik, Selawik, Shishmaref, Shungnak and Teller. The maximum and average concentrations, considering all villages, were 24.27 nCi/kg and 4.37 nCi/kg, respectively. The average radiation dose index was 34.1 mrad/a. A comparison of the radiation dose indices of individuals counted both in the spring of 1967 and the spring of 1968, indicates that in two villages out of ten there was a significant decrease in the indices. The inhabitants of villages living on a diet of caribou or moose meat had a higher ^{137}Cs burden than the inhabitants of villages where reindeer herds supply the main meat source. The calibration formulas of Rechen and Palmer are compared and it is concluded that earlier studies made by Hanson and Palmer are compatible with the more recent studies made by the U. S. Public Health Service. (auth)

34235 DATA. SECTION I. MILK AND FOOD. Radiol. Health Data Rep.; 11: 237-50(May 1970).

Agencies throughout the Western Hemisphere that report regularly on the content of fallout radioisotopes in milk were surveyed for information on analytical methodologies, sampling and analysis frequencies, and estimated analytical errors associated with the data. It is pointed out that milk can be used as the indicator food for routine environmental fallout surveillance. A summary of the radiation protection guides provided by the Federal Radiation Council for specific environmental radiation exposure is included. Data are included on the content of ^{137}Cs, ^{131}I, and ^{90}Sr in milk samples collected throughout the USA, Canada, Central America, and South America during 1969 and January 1970. Data are also included on the content of ^{137}Cs, ^{226}Ra, ^{89}Sr, and ^{90}Sr in a representative diet in California during the last quarter of 1968 and the first quarter of 1969. (C.H.)

34236 DATA. SECTION II. WATER. Radiol. Health Data Rep.; 11: 251(May 1970).

Standards for gross α and β radioactivity and content of ^{226}Ra and ^{90}Sr in drinking water in the USA, based on Federal Radiation Council recommendations, are reviewed. (C.H.)

Genetics and Cytogenetics

Refer also to abstracts 34138, 34318, 34406, 34564, 34565, 34574, 34607, 34626, 34637, 34639, 34687, 34720, 34755, 34761, and 34796.

34237 (LF-41, pp 185-91) ^{60}Co-INDUCED METAPHASE CHROMOSOME ABERRATIONS IN CHINESE HAMSTER LIVER CELLS. Brooks, A. L.; Rollag, M. D.; Peters, R. F. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.).

The number and type of metaphase chromosomal aberrations induced by ^{60}Co γ irradiation in the Chinese hamster liver were determined using partial hepatectomy to stimulate mitotic activity, and colchicine injection to accumulate metaphase cells for chromosomal evaluation. The liver cells of the Chinese hamster have approximately the same sensitivity to induction of aberrations at all stages of the cell cycle and the types of abnormalities change as the cell progresses through the cycle with chromosomal aberrations predominating in G_0 and G_1, and chromatid aberrations predominating in S and G_2. These changes are roughly correlated with the onset of DNA synthesis. Dose-response curves for metaphase aberrations were established and liver cells were found to be more resistant to radiation-induced aberrations than many other metaphase systems. The number of aberrations observed per cells per R was similar regardless of whether the animals were hepatectomized at one hour or one week after the radiation exposure. The advantages of scoring metaphase cells compared to anaphase or telophase cells are discussed. (auth)

34238 (ORO-3596-10) EFFECTS OF RADIATION ON DNA AND DNA REPLICATION. Progress Report, August 1, 1968-July 31, 1969. (Florida Univ., Gainesville. Radiation Biology Lab.). 7p. Dep. CFSTI.

Ultraviolet and x irradiation of Escherichia coli resulted in premature initiation or abnormal initiation sites for chromosome replication. Progress is reported on investigation of subsequent replications of these irradiated chromosomes. Hydrolysates of DNA from uv-irradiated cells of a lysis-defective strain of E. coli contained an increased amount of methyl label in the thymine and a decreased amount in the 5-methyl cytosine and 6-methyl adenine fractions. Work is in progress to determine whether uv-radio-induced hypomethylation and increased methyl label in the thymine is related to prophage induction. Preliminary experiments on repair of radiation damage suggest that the incorporation of post-irradiation precursors in the parental DNA of E. coli B/r hcr^+ is a property of the Hcr^+ system and does not include "recombination synthesis" in detectable amounts. Investigation of the radioprotective effects of mercaptoethylamine on γ-radioinduced single strand breaks and molecular damage in the DNA of bacteriophage ϕX174 is also in progress. (M.M.B.)

34239 (RLO-2045-5) UV MICROBEAM STUDIES ON MITOSIS. Comprehensive Report for 1967-70. Bajer, Andrew S. (Oregon Univ., Eugene. Dept. of Biology). Contract AT(45-1)-2045. 25p. Dep. CFSTI.

The mitotic spindle in endosperm cells of Haemanthus katherinae Bak. was irradiated with a UV microslit (4×90 μm) and a UV microbeam (4 to 20 μm diameter). Irradiation was done through a reflecting condenser using Zeiss, Jena equipment. The entire HBO-200 spectrum, wide band UV, and 280 μm λ (interference filter) were used. Chromosome movements recorded with time-lapse film and analyzed frame by frame, or the cells were fixed at various times after irradiation (gluteraldehyde, postfixed with osmium tetroxide) for subsequent studies with the EM. The irradiated region was studied in every second to fourth section throughout the cell. Cells in metaphase and anaphase were studied most extensively. The effect of low doses was not detected on either the LM or EM levels; at higher doses, chromosomes can be slowed down or stopped. If the half-spindle is irradiated with the UV microslit between kinetochores and the poles (close to the kinetochores) during anaphase, chromosomes in the opposite half-spindle may continue their poleward movement, while the sister chromosome group in the irradiated half-spindle may move backward. Chromosome bridges can easily be produced in anaphase if chromosome arms or kinetochores are irradiated in prophase-metaphase or the onset of anaphase. If strong bridges develop, they usually result in the formation of the restitution nucleus. A restitution nucleus may also form in telophase if the phragmoplast does not form as a result of irradiation of the interzonal region, or if chromosome movement is stopped early in anaphase. No detectable effect, on the EM level, has been found in cells fixed immediately after irradiation, nor in cells fixed 10 or more minutes after irradiation with moderate doses. In cells fixed 1 to 5 minutes following irradiation with high or medium doses pronounced changes have often been found in the mitotic spindle. The number of microtubules (MTs) are reduced in the irradiated and adjacent regions and perforated lamellae and vesicles are abundantly formed. The spindle is gradually disorganized in cells irradiated with high doses leading to the formation of restitution nuclei, and the effect of UV is quickly spread to neighboring regions of the spindle. Gradual disorganization of kinetochore fibers is very characteristic. Kinetochore fibers become shorter and an increasing number of vesicles is seen in the region previously occupied by kinetochore MTs. The data on chromosome behavior indicate that the chromosomes slow down or may even stop a short time (less than 1 min.) before clear changes on the fine structure level are seen. The results are in agreement with data from studies with the polarizing microscope correlating changes of birefringence in the irradiated region of the spindle with fine structure. (Sato, Bajer, and Molè-Bajer, in preparation.) The data on fine structure clearly indicate that precise focusing of the UV beam is essential to affect both chromosome movement and MTs. This is indicated by the fact that the effect of UV in a cell is found in only a very thin region (about 2 μm) unless a lethal dose is applied. Results obtained in these experiments can be expected on the theoretical consideration of UV energy distribution in the irradiated region. (auth)

34240 ISOLATION OF HIGHLY PROTEOLYTIC MUTANTS FROM ASPERGILLUS SOJAE. Sekine, Hiroshi; Nasuno, Seiichi (Noda Inst. for Scientific Research, Chiba, Japan). Agr. Biol. Chem. (Tokyo); 33: 1477-82(Oct 1969).

Mutational experiments were performed to improve the protease productivity of the mutant strain X-816 previously induced by x irradiation from Aspergillus sojae K.S. as a high protease producer. A significant correlation was found between the protease production in wheat bran koji and the clear zone around a fungal colony formed on a special medium containing casein. Several mutants of high protease productivity were obtained by the use of the clear zone as a simple criterion for a primary screening test. The composition of some other hydrolytic enzymes in wheat bran koji and the genetic stability of these mutants are also discussed. (auth) (NSA of Japan)

34241 EFFECT OF RADIATION ON THE FUNCTIONS OF CARCINOGENIC VIRUSES. Latarjet, R. (Inst du Radium, Paris). pp 13-19 of Radiation-Induced Cancer. Vienna: International Atomic Energy Agency (1969). (In French).

From Symposium on Radiation-Induced Cancer, Athens, Greece. See STI/PUB-228; CONF-690404.

When carcinogenic viruses are irradiated under suitable experimental conditions with ultraviolet rays or ionizing radiation, the various viral functions can be dissociated and virions defective in certain functions can be obtained. These defects are real mutations; they are passed on to subsequent generations provided the virions affected remain capable of reproduction. It has been possible to obtain various types of mutant, e.g., hyperproducers of virions, non-productive transformers, non-transforming producers. The production of these mutants opens up certain experimental possibilities with regard to the transformation mechanism and the possible consequences of irradiation in vivo. Attention will be devoted in particular to the increased oncogenic capability in vivo that is sometimes observed in pre-irradiated viruses, and also to the consequences of this effect in the radiotherapy of certain malignant infections. These studies are also of interest for analyzing the structure of the viral genome and throwing light on that fraction of the genome that is responsible for the transforming capacity. In the case of small viruses with a single DNA molecule (polyoma, SV-40), it was possible to measure the fraction of the molecule responsible for the transforming capacity. In the case of the Rous virus the experiments suggest that the viral RNA is made up of sub-units capable of independent replication, the transforming capacity being possessed by only one of these sub-units. The induced defect may reveal the presence of transforming capacity in a virus considered as non-oncogenic because the transformed cells are usually eliminated by the infective process. In this way irradiation could render carcinogenic a virus which is not carcinogenic under normal conditions. (auth)

34242 RADIOMIMETIC EFFECT OF ONCOGENIC AND NON-ONCOGENIC HUMAN AND SIMIAN ADENOVIRUSES. Stich, H. F. (Univ. of British Columbia, Vancouver). pp 21-5 of Radiation-Induced Cancer. Vienna; International Atomic Energy Agency (1969). (In French).

From Symposium on Radiation-Induced Cancer, Athens, Greece. See STI/PUB-228; CONF-690404.

The capacity of human (AD2, 4, 7, 12, 16, 18, 31) and simian (SA7, SV20) adenoviruses to induce chromosome aberrations and to affect the proliferative capacity and cloning efficiency was examined using permissive (AV-3, HEp-2, CV-1 cell strains) and non-permissive (BHK-21, primary Syrian hamster cultures) cell systems. The comparative study revealed that genetically abnormal cells are only induced when the viral replication cycle is incomplete or when cells are infected with defective or experimentally (uv-irradiation, hydroxylamine treatment) impaired viruses; that the chromosome damaging capacity of one virus is comparable to that of about 2 rads of x ray; and that the viral genome, which can survive in the host cells, represents a self-replicating mutagenic agent capable of continuous induction of new cell mutants. Frequency of cells with chromosome aberrations, incidence of chromatid breaks per cell, loss of cloning efficiency and the formation of virus-induced T(tumor)-antigen, which is coded for by the parental viral DNA molecule but is apparently not a part of the viral coat, depend on the viral dose. The chromosome damaging factor(s) seem not to reside in the virus particle but appears to be a viral product(s) from which transcription occurs in the early stages of the viral replicative cycle. It is suggested that viruses might represent an important etiologic factor in the mutagenesis of higher organisms. (auth)

34243 SOMATIC MUTATIONS IN RADIATION CARCINOGENESIS. Curtis, H. J. (Brookhaven National Lab., Upton, N. Y.). pp 45-55 of Radiation-Induced Cancer. Vienna; International Atomic Energy Agency (1969). (BNL-13430).

From Symposium on Radiation-Induced Cancer, Athens, Greece. See STI/PUB-228; CONF-690404.

It now seems quite certain that tumors in mammals arise from single somatic cells. This gives support to the mutation concept of carcinogenesis, but the form of the induction curves for tumors, as well as other facts, precludes the acceptance of a simple mutation theory. A hypothesis was formulated that postulates several sequential steps required to finally transform a cell to a cancerous form. The mathematical formulation of this theory fits the known tumor induction data. Laboratory support for this theory comes from studies of chromosome aberrations in mice, and radiation-induced hepatomas in mice. In the chromosome studies, the aberration frequency is found to be proportional to the number of tumors induced in animals under a wide variety of conditions, not only of different kinds of radiation and radiation treatment regimes, but other influences such as genetic background and various chemical treatments. These studies lend potent support to the concept that a mutation is a necessary, but not a sufficient, condition for cancer induction. The hepatoma experiments have been done with LAF1 mice which rarely develop hepatomas spontaneously, and they show about 15% hepatomas 20 months after a large dose of radiation, and about 70% if the radiation is followed by partial hepatectomy. This shows that an early step in the process is mutation, and this must be followed by a stimulus for cell division. A recent experiment has shown that mutations are not involved in the later steps, since no more hepatomas were induced when the radiation treatment and partial hepatectomy were followed by another dose of radiation. Recovery processes are very important in determining ultimate radiation damage, and the hepatoma technique has been used to show that once a carcinogenic mutation is established in the genome of a somatic cell, there is no genetic recovery for the lifetime of the animal, and this is true for both x-ray and neutron-induced mutations. It thus appears that some of the steps in the carcinogenic process are beginning to be understood, but there are still many unknown factors. (auth)

34244 CHROMOSOME ABERRATIONS INDUCED IN HUMAN PERIPHERAL BLOOD BY 2-MeV X-IRRADIATION TO THE WHOLE BODY AND IN VITRO. Buckton, Karin E. (Medical Research Council, Edinburgh); Langlands, A. O.; Smith, P. G.; Looby, P. C.; Woodcock, G. E.; McLelland, J. pp 135-46 of Radiation-Induced Cancer. Vienna; International Atomic Energy Agency (1969).

From Symposium on Radiation-Induced Cancer, Athens, Greece. See STI/PUB-228; CONF-690404.

In recent years it has proved possible to correlate the incidence of ring and dicentric chromosomes in cultured human peripheral blood lymphocytes with given radiation doses, both in vitro and following partial or whole-body irradiation exposure in vivo. In the present study a comparison is made between the yield of aberrations in six men with advanced cancer who received whole-body irradiation in doses varying between 36 and 50 rads and the yield of aberrations in samples of their blood drawn before exposure and irradiated in vitro simultaneously to the same dose. A comparison is also made between the yield of aberrations following in-vitro irradiation to much higher doses of blood derived from these same cancer patients and blood from non-cancer controls. The significance of these findings is discussed with reference to biological dosimetry using chromosome aberrations as the parameter for both external and internal irradiation. Apart from such a practical application it also appears possible to develop this technique to study the sensitivity of cells to chromosome breakage by radiation in selected populations such as mongols, or persons with Fanconi's anemia where there is a higher than normal incidence of malignant disease. (auth)

34245 CYTOGENETICS OF POST-IRRADIATION MOUSE LEUKAEMIA. Wald, N.; Pan, S.; Upton, A.; Brown, R. (Univ. of Pittsburgh. Oak Ridge National Lab., Tenn.). pp 249-64 of Radiation-Induced Cancer. Vienna; International Atomic Energy Agency (1969).

From Symposium on Radiation-Induced Cancer, Athens, Greece. See STI/PUB-228; CONF-690404.

The interrelationship between radiation, cytogenetic abnormalities, and viruses in leukaemogenesis has been studied in the RF/Un mouse which develops a high incidence of granulocytic leukaemia on radiation exposure. A virus-like agent has been demonstrated in such leukaemic animals and the disease has been transmitted by passage of apparently acellular materials from irradiated primary animals to normal recipients. Pilot cytogenetic studies revealed consistent abnormal chromosome markers and modal shifts in both irradiated leukaemic animals and in non-irradiated animals developing leukaemia after passage injection. To define better the relationship between consistent bone-marrow chromosome aberrations and post-irradiation primary and passaged leukaemia, 100 RF/Un mice were studied which were irradiated with 300 R of 250-kVp x-rays at 100 weeks of age and subsequently developed leukaemia. Eighty-seven had granulocytic leukaemia and in 72 of these, bone-marrow cytogenetic abnormalities were found. The distribution of numerical and structural chromosome aberrations in 3225 cells studied is reviewed in detail. The correlation of specific aberrations to clinical and histopathologic findings has been attempted. Sequential passages of apparently cell-free material from the post-irradiation leukaemic mice into unirradiated RE/Un recipients and subsequent passages from leukaemic recipients were performed to observe the evolution of any initial chromosome markers and shifts in modal chromosome number in the passage generations. Two-hundred-thirty-six mice were inoculated with the material obtained either from primary postirradiation leukaemic mice or from serially-passaged leukaemia cases. In the most extensive passaged line, 22 transfer generations containing 129 leukaemic mice were examined by clinical, histopathologic, haematologic and cytogenetic procedures. Evolution of abnormal chromosome modes from 41 in the early passages to 39 chromosomes consistently after the 4th transfer generation was observed. The rela-

tionship of these changes to the clinico-morphologic characteristics of the leukaemia is under analysis. Both positive and negative experimental evidence accumulated concerning the acellularity of the passaged material is considered. (auth)

34246 CHROMOSOME STUDIES IN PATIENTS WITH POLYCYTHAEMIA VERA AFTER TREATMENT WITH ^{32}P. Millard, Rosemary E.; Kay, H. E. M.; Lawler, S. D. (Royal Marsden Hospital, London). pp 289-303 of Radiation-Induced Cancer. Vienna; International Atomic Energy Agency (1969).

From Symposium on Radiation-Induced Cancer, Athens, Greece. See STI/PUB-228; CONF-690404.

The chromosomes of bone-marrow cells and blood lymphocytes of forty-six patients with polycythemia vera were analyzed to trace the sequence of events leading to the development of bone-marrow failure or "leukemia". All except one of the patients had received radiophosphorus (^{32}P). It might be expected that the yield of chromosomal aberrations of the two-break type (translocations etc.) from the low dose-rate beta radiation of ^{32}P would be small. However, "unstable" types of abnormality (dicentrics, fragments) and "stable" types (translocations, inversions, deletions) were observed in 6 to 25% of the blood lymphocytes; there was no evidence of clones of abnormal cells. In the majority of patients the bone marrow was predominantly normal diploid; occasional sporadic cells with "stable" chromosomal abnormalities were seen in two-thirds of the cases, but "unstable" aberrations were rare. In seven cases there were clones of cells characterized by deletions or translocations. All these chromosomal changes are probably radiation-induced. Clones of cells with a similar abnormality, an apparent deletion of one of the F-group chromosomes, were observed in the bone marrow in ten patients. Eight of these had received ^{32}P and two busulphan. In two cases the clone appeared to develop after treatment. A similar anomaly has been reported in several cases of idiopathic sideroblastic anemia who had not been irradiated. Progression into the "leukemic" phase of the disease is associated in some cases with gross chromosomal abnormalities, such as shift of the stem line chromosome number and bizarre chromosome "markers". In other cases, some of whom have not been irradiated for several years, the chromosomal changes are less pronounced and may result from non-disjunctional gain of one or more chromosomes or chromosome loss. One case showed a step-by-step clonal evolution over a two-year period. None of the chromosomal abnormalities in the "leukemic" phase appear to be a direct result of radiation-induced chromosomal breakage. (auth)

34247 SMALL SYMPOSIA OF THE XII INTERNATIONAL CONGRESS OF GENETICS, TOKYO, JAPAN, AUGUST 19-28, 1968. Hiroyoshi, Toshiki (ed.). Idengaku Zasshi, Suppl.; 44: No. 1, 1-453(Jul 1969). (CONF-680844).

This supplement contains the texts or abstracts of 62 of the 124 papers presented at the small symposia. Included are papers on genetic control of molecules and cell differentiation, lysogeny, chromosome structure, isozymes, infectious heredity in higher organisms, cytogenetics of tumors, B-chromosomes, molecular basis of mutation, repair processes, role of epistasis and linkage in evolution, maintenance of protein and polygenic variability and lethal and detrimental genes in natural populations, genetics of migration and isolates, radioinduced chromosome aberrations in exposed individuals, molecular basis of hereditary diseases, selection experiments, evolutionary dynamics, mutation and male sterility in plant breeding, R and related factors, industrial applications of microbial genetics, and sexuality and its genetics in ciliate protozoa. Separate abstracts have been prepared for 11 of the papers. (M.M.B.)

For abstracts of individual papers see: 34248-34256, 34564, and 34565.

34248 SOMATIC MUTATION IN MAMMALIAN CELLS. Nichols, Warren W. (Inst. for Medical Research, Camden, N. J.). Idengaku Zasshi, Suppl.; 44: No. 1, 58-64(Jul 1969).

From 12th International Congress of Genetics, Tokyo, Japan. See CONF-680844.

Interest in somatic mutation is centered primarily around the problems of carcinogenesis, and to a lesser extent, aging. In work and speculation on aging, both in vivo and in recent studies of diploid cells in vitro, the predominant theories have evoked somatic mutations. The present discussion of somatic mutation will be in the context of both virus induction of mutation and carcinogenesis. Viruses have been shown to be capable of producing at least three types of change involving chromosomes (3). The first of these is the single break; the second, chromosome pulverization; and the third, spindle abnormalities resulting in new chromosome grouping. While all of these could be important in carcinogenesis, we will concentrate on the single break, since it seems the most likely to be involved in somatic mutation. The finding of chromosome breaks in association with viral infection does provide one common denominator between the known groups of carcinogenic agents. Irradiation and carcinogenic chemicals have been known to produce chromosome defects for some time. Final proof of the role of viruses in somatic mutation, and somatic mutation in carcinogenesis will evolve with the elucidation of the molecular mechanism and pathogenesis of the virus induced chromosomal changes. At the present time there is a great deal of work on the mechanisms of viral induced chromosome damage and somatic mutation. This includes studies on the inhibition or interference of cellular DNA synthesis, effects on cellular organelles as the lysozome, effects on interference or inhibition of protein synthesis, and the possibility of a direct combination between viral and cellular nucleic acid. At the present time no definitive answers are possible, but there are indications that several different mechanisms may be involved. (M.M.B.)

34249 IDENTIFICATION OF THE GENETIC ALTERATIONS IN SPECIFIC LOCUS MUTANTS AT THE MOLECULAR LEVEL. De Serres, F. J.; Malling, H. V. (Oak Ridge National Lab., Tenn.). Idengaku Zasshi, Suppl.; 44: No. 1, 106-13(Jul 1969).

From 12th International Congress of Genetics, Tokyo, Japan. See CONF-680844.

Neurospora crassa strains in which point mutations have been induced at the ad-3 loci will grow as homokaryons on minimal media supplemented with adenine, whereas those strains in which chromosome deletions have been induced will not. It was shown that x-radioinduced lesions which produce point mutations are qualitatively different from those lesions that cooperate in pairs to produce chromosome deletions. When the dose rate was varied from 1000R/min to 10R/min repair of lesions producing deletions occurred but not repair of lesions producing point mutations. Dose effect curves obtained with the two dose rates are similar when point mutations are measured but multilocus deletions are much less frequent among mutants induced by 1000R/min. On those portions of these latter curves where the slope is 2.0 the dose-reduction factor is about 3.2. Genetic analysis of recessive lethal mutations resulting from deletions was made possible by homology tests in which test mutants and tester strains were combined in various combinations to determine whether they have genetic damage in common. Tests involving allelic complementation and specific reversibility after treatment were devised to characterize and identify damage at the molecular level in point mutations. The resulting data suggest that mutations resulting exclusively from adenine-thymine pairs (AT) to guanine-cytosine pairs (GC) transitions have a higher percentage of allelic complementation, with the majority showing nonpolarized patterns, and that mutants resulting from GC to AT transitions show a lower percentage of allelic complementation, with complementary mutants having both polarized and nonpolarized patterns. These conclusions were supported by data obtained from testing various chemically-induced and uv-radioinduced mutations. (M.M.B.)

34250 REPAIR IN MUTATION PROCESS STUDIES IN LOW AND HIGH RADIOSENSITIVITY STRAINS OF THE SILKWORM. Tazima, Yataro (National Inst. of Genetics, Misima, Japan). Idengaku Zasshi, Suppl.; 44: No. 1, 123-30(Jul 1969).

From 12th International Congress of Genetics, Tokyo, Japan. See CONF-680844.

Based on our results obtained with the use of low and high radiosensitivity strains of the silkworm, repair of radiation induced premutational damages is briefly discussed. A direct evidence of repair of premutational damages was obtained by split-dose irradiation to spermatogenic cells, mostly spermatids, in full-grown larvae. Applying similar treatment to several strains, different in radiosensitivity, we discovered that only low sensitivity strains were capable to repair radiation induced premutational damages, while sensitive strains lacked this ability. Postirradiation treatment with nitrogen or oxygen affected only slightly the mutation frequency. In contrast anoxic irradiation (in nitrogen atmosphere) decreased it to an appreciable extent. The dose reduction effect of anoxic irradiation varied depending on the type of mutation, being more pronounced for mosaics than for whole body mutants. These findings seem to suggest that most premutational damages produced by anoxic irradiation on one of the double helices of DNA are more likely to be repaired than those produced on both. (auth)

34251 NATURE OF SELECTION RESPONSES IN TRIBOLIUM. Bell, A. E. (Purdue Univ., Lafayette, Ind.). Idengaku Zasshi, Suppl.; 44: No. 1, 299-309(Jul 1969).

From 12th International Congress of Genetics, Tokyo, Japan. See CONF-680844.

Quantitative characters, primarily related to growth and development, were studied in selection experiments on the flour beetle, Tribolium castaneum. The response to selection under various genetic and environmental conditions is described. Enhanced

genetic variability was observed in x-irradiated lines. However, in contrast to finding with Drosophila, the increase in variability was more than offset by a decline in reproductive fitness which resulted in less response to selection. (M.M.B.)

34252 RELEASE OF MUTAGEN-INDUCED GENETIC VARIABILITY IN OATS BY OUTCROSSING. Frey, K. J. (Iowa Agricultural and Home Economics Experiment Station, Ames). Idengaku Zasshi, Suppl.; 44: No. 1, 396-403(Jul 1969).

From 12th International Congress of Genetics, Tokyo, Japan. See CONF-680844.

For this study, 29 M_5-derived and eight random check oat lines (C_5) were chosen from radiated and nonradiated populations of Clintland variety. The M_5- and C_5-derived lines were identical in appearance and produced similar grain yields, 100-seed weights, plant heights and heading dates. The 29 M_5-derived and seven of the C_5-derived lines were crossed as females to one C_5 line used as a male. From each of the 36 crosses, 20 F_2-derived lines were tested for grain yield, 100-seed weight, plant height and heading date. Variation among F_2-derived line means within crosses was judged significant or non-significant via an F-test. Significant variation among F_2-derived lines did not occur for any trait in any of the seven crosses in which C_5-derived lines were used as females, indicating that the parental variety, Clintland, was genotypically homogeneous. However, the crosses in which M_5-derived lines were used as females showed significant variation among F_2-derived line means in 23, four, seven and three of 29 cases for grain yield, 100-seed weight, plant height and heading date, respectively. Furthermore, the distribution of cross means and F_2-derived lines means was distributed approximately equally above and below the check mean. Twenty-three and 27 F_2-derived line means yielded above and below the highest and lowest lines, respectively, from crosses involving C_5 female parents. (auth)

34253 GENETIC CHANGES IN QUANTITATIVE CHARACTERS OF IRRADIATED POPULATION. Borojevic, Katarina (Univ. of Novi Sad, Yugoslavia). Idengaku Zasshi, Suppl.; 44: No. 1, 404-16(Jul 1969).

From 12th International Congress of Genetics, Tokyo, Japan. See CONF-680844.

The effects of irradiation and selection on plant height and number of kernals per main spike were studied in Triticum aestivum ssp. vulgare. In populations derived from γ or x-irradiated seeds the mean values for both characters were lower (about 10%) and the variability was increased in the M_2 and M_3 generations. These values tended more toward control values in later generations. Stabilization took place in the M_5 and M_6 generations at mean values higher (5 to 6% for kernal number) or lower (3 to 5% for plant height) than control populations. Selection applied at this time was more effective than when applied earlier. (M.M.B.)

34254 UTILIZATION OF CHRONIC IRRADIATION IN MUTATION BREEDING. Yamaguchi, Hikoyuki (Tokyo Univ.). Idengaku Zasshi, Suppl.; 44: No. 1, 425-30(Jul 1969).

From 12th International Congress of Genetics, Tokyo, Japan. See CONF-680844.

Irradiation of dry seeds shows only a little, if any, dose-rate dependence if the storage effects are properly subtracted. If dry seed is irradiated, there are fewer mutations than if germinated seed, seedling or growing plant is treated. This is thought to result from the fact that the metabolic activity is very low in dry seed. After chronic irradiation of growing plant, less lethality is frequently observed than after the acute exposure of comparable dosage. Cytological alteration arising in the vegetative shoot apex of tea plants with chronic exposure seems to show no basic difference from that occurring with acute. It has been found, however, an effect of decreasing yield following decreased dose-rate. The rate of chlorophyll mutations in barley plant appears to be independent of the dose-rate or of the developmental stage in which the radiation is applied, except a slight increase of mutations following irradiation immediately after meiosis. When the dose is given chronically at low intensities, one could use higher doses and thus achieve absolutely higher mutations rates than if the dose is exposed all at once at high intensity, being limited by the severe radiation damage. Chronic treatment with the large gamma-source is especially suited for the flowering, fruiting or forest trees and shrubs. In general, the needleleaf tree produces more mutated shoots than the broad-leaf species do. Numbers of wholly mutated shoots have been gained in the former, while a high percentage of chimaeric appearance of mutations is obtained in the latter. Mutant shoots may be induced from broad-leaf plants chronically exposed to gamma-rays, using the cutting-back method. Recurrent radiation, done once per generation at low intensities without the severe radiation damage, causes an enrichment of mutants in rice population. The slope of the regression indicates that the larger the accumulated doses, namely the cycles of radiation, the greater is acquirement of the mutants with altered morphology. (auth)

34255 RELATIVE BIOLOGICAL EFFECTIVENESS OF HIGH LET RADIATIONS IN HIGHER PLANTS. Fujii, T. (National Inst. of Genetics, Misima, Japan). Idengaku Zasshi, Suppl.; 44: No. 1, 431-42(Jul 1969).

From 12th International Congress of Genetics, Tokyo, Japan. See CONF-680844.

Data are presented on the RBE (with reference to γ radiation from ^{60}Co and ^{137}Cs) of high LET radiations for induction of chlorina mutants in heterozygous seeds of diploid wheat (Triticum monococcum), for induction of glabrous mutants in F_2 seeds of Arabidopsis thaliana, for survival in dry and wet seeds of A. thaliana, and for induction of bronze in Zea mays pollen. The RBE of 14 MeV neutrons was measured in all these systems and varied from 5 to 15. Fission neutrons were measured for induction of glabrous mutants and gave a RBE of 16. The heavy particles were tested for induction of glabrous mutants and for effects on survival; ^4He particles had RBEs of 10 and 40 respectively, ^{12}C had 35 and 20, and ^{40}Ar had 5 and 10. For practical use 14 MeV neutrons appear to be the most efficient mutagen since heavy particles require special equipment. Water content appeared to modify the RBE of fast neutrons considerably since wet seeds gave a RBE of 5 compared to 10 for dry seeds. (M.M.B.)

34256 NEUTRON IRRADIATION OF SEEDS AS A TOOL IN PLANT GENETICS AND BREEDING. Smith, Harold H. (Brookhaven National Lab., Upton, N. Y.). Idengaku Zasshi, Suppl.; 44: No. 1, 443-53(Jul 1969).

From 12th International Congress of Genetics, Tokyo, Japan. See CONF-680844.

Maize plants grown from seeds that had received various absorbed doses of fission neutrons (N) or of 250 kVp x rays (X) were scored for radiation damage on the basis of nine criteria which monitored effects ranging from sublethal genetic damage, to gamete lethality, to selective somatic cell death, to complete cessation of cell division. The relative responses at each end point can be fitted to the linear equation: $\log N = -2.6 + 1.96 \log X$ over a range of neutron doses that spans four orders of magnitude. This simple power relation that is maintained throughout suggests that the responses measured have a common cause, namely chromosome breakage and genetic loss, that increasing somatic damage is attributable directly to quantitatively more genetic damage, that the neutron-induced damage increases linearly with dose and x-ray-induced damage with the approximate square (1.96) of the dose, and that this relationship remains uncomplicated from the irradiated seed through the development of the maize plant. Plant height was selected for in populations of Nicotiana tabacum derived from thermal neutron-irradiated seeds. The variability induced was responsive to selection in both directions from the mean height of control populations. The variants so isolated were tested for electrophoretic patterns. Some of the mutant lines were found to have protein bands which differed from the controls and each other. One of these appeared to involve the loss of a block of genes controlling the synthesis of two peroxidase and one esterase isozyme. (M.M.B.)

34257 PROCEEDINGS OF THE XII INTERNATIONAL CONGRESS OF GENETICS, TOKYO, JAPAN, AUGUST 19-28, 1968. VOLUME III. REPORTS, RECORDS, PLENARY LECTURES, AND INVITED LECTURES. Oshima, C. (ed.). Tokyo; Science Council of Japan (1969). 538p. (CONF-680844-(Vol.3)).

Five plenary lectures are included in this volume. They are concerned with the history of science in Japan, genetics in 1968, premutational damage, H. J. Muller, and molecular and population genetics. Invited lectures on progress in genetics included 20 papers on molecular, microbial, biochemical, cellular, radiation, population, evolutionary, applied, and human genetics and mutation studies. Four papers presented at a J. B. S. Haldane memorial session, reports, records, and a program of the congress, and a list of members and officers are all included in this volume. Separate abstracts of five of the above papers and lectures have been prepared. (M.M.B.)

For abstracts of individual papers see: 34258-34262.

34258 CLASSIFICATION OF CHROMOSOME PREMUTATIONAL DAMAGE. Dubinin, Nikolay P. (Inst. of General Genetics, Moscow). pp 79-92 of Proceedings of the XII International Congress of Genetics, Tokyo, Japan, August 19-28, 1968. Volume 3. /Oshima, C. (ed.). Tokyo; Science Council of Japan (1969).

See CONF-680844-(Vol.3).

The idea of potential chromosome changes, during gene mutations and during the appearance of chromosome aberrations, is at present one of the principal working hypotheses in the analysis of

the nature of mutagenesis. The studies are essential, in which the effect of short and long living mutagens is distinguished and the conditions are created which allow the phase of DNA synthesis (S phase) from the moment of cell treatment with mutagens. The studies on the system of dry seeds and on synchronous cell population in rat liver revealed a dynamic picture of prolonged mutagenesis. While storing the dry seeds the existence of a number of waves in the level mutability was ascertained. In the cells of rat liver the effect of time factor was discovered. These facts account for the presence of long living potential changes. Evidently the primary change in DNA molecule does not result at once in the appearance of a stable mutation. Potential changes in the course of time undergo the developmental and reparation processes replacing each other. It is necessary to study the molecular nature of those metastable states, the initial potential damages of chromosomes being such, as well as the transformation of these states through the development and reparations in the course of different phases of prolonged mutagenesis. (auth)

34259 RECENT ADVANCES IN RADIATION GENETICS WITH EMPHASIS ON REPAIR PHENOMENA. Sobels, Frederik H. (Univ., Leiden). pp 205-23 of Proceedings of the XII International Congress of Genetics, Tokyo, Japan, August 19-28, 1968. Vol. 3. /Oshima, C. (ed.). Tokyo; Science Council of Japan (1969).

See CONF-680844-(Vol.3).

The review is restricted mainly to genetic effects of ionizing irradiation in animal cells. Particular consideration has been given to the nature of the radiation-induced lesions and the extent to which these can be repaired. Recent studies with E. coli and Neurospora suggest that X-rays can induce mutations which originate from single base changes. Little is known as yet about repair of X-ray induced premutational damage in bacteria. In Paramecium metabolic repair is possible until DNA replication; in G_2 phase practically all damage can be repaired. Mutations increase linearly with dose, and chromosome aberrations cannot account for more than 20% of the damage. In mouse oocytes, the yield of specific locus mutations is reduced at low dose rates, with dose-fractionation and at low doses of acute irradiation. These findings considered together with high RBE values after fast neutron irradiation may indicate a two-hit component among the specific locus mutations. Translocations induced by X-rays in spermatogonia increase linearly with dose and their yield is not affected by changes in dose rate. Following low LET gamma irradiation, however, a pronounced dose rate dependence for translocation induction is observed. The dose rate effect for translocations in spermatogonia is different from that observed for specific locus mutations, which may suggest different mechanisms. Complete absence of mutations in mouse oocytes is observed when the interval between irradiation and conception exceeds 7 weeks. Primordial human and monkey oocytes are characterized by far greater resistance to radiation-induced cell killing than those of the mouse. A lower mutation frequency has been recorded for a new set of specific loci; estimates for recessive lethal mutations in the whole genome have been obtained, and are likewise somewhat lower than would have been expected on earlier data. Observations on early gonial cells of the silkworm suggest dose-rate dependent repair. The reverse dose rate effect in later gonial cells results from an accumulation of the radiosensitive G_2 cells after chronic exposure. In Drosophila, evidence for the operation of repair processes comes from studies on post-radiation modification. Following X-irradiation in N_2, repair of mutations and chromosome breakage events in spermatozoa is favored by N_2, but in spermatids by O_2. Artefacts due to differential sampling of cells with different radiosensitivities can be excluded. In sperm, the energy required for repair is presumably generated by glycolysis, because pretreatment with NaF increases the mutation frequency and this is not an oxygen-effect. Combination of NaF with post-radiation exposure to N_2 or O_2 suggests that the amount of repair in sperm depends on different levels of available energy. Studies on oxygen-dependent repair in spermatids indicate that a repair system which has been inhibited by anoxia can be reversed to normal functioning by post-treatment with O_2. Post-radiation modification of translocation yields in both sperm and spermatids indicates repair of potential lesions, rather than an effect on restitution of open breaks. The data in Drosophila males suggest that only a fraction of all radiation-induced lesions are reparable, and that this consists not only of potential breaks but also of damage leading to point mutation. Oxygen-dependent repair for dominant lethal yields has also been demonstrated for stage 7 oocytes. From allelism studies of radiation-induced recessive lethals, Lifschytz and Falk infer that in post-meiotic cells of Drosophila, radiation mainly produces mutation by breakage events. From the observation that isochromosomes showing homozygosity of markers can be induced in spermatozoa and spermatids, it is inferred that the chromosome in post-meiotic stages may consist of two sub-units between which whole-arm exchanges can occur. These exceptional genotypes cannot be explained by spontaneous occurrence in gonial cells, second division non-disjunction or misdivision of the centromere. (auth)

34260 ROLE OF DNA REPAIR AND RECOMBINATION IN MUTAGENESIS. Witkin, Evelyn M. (State Univ. of New York, Brooklyn). pp 225-45 of Proceedings of the XII International Congress of Genetics, Tokyo, Japan, August 19-28, 1968. Vol. 3. /Oshima, C. (ed.). Tokyo; Science Council of Japan (1969).

See CONF-680844-(Vol.3).

The repair of pyrimidine dimers by photoreactivation or by excision repair prevents many mutations by eliminating the potentially mutagenic dimers from the DNA. Photoreactivation is at least ten times less likely to cause a mutation than is an unrepaired dimer, and excision repair is at least one hundred times less likely to do so. The post-replication repair of daughter-strand gaps in the DNA opposite unrepaired pyrimidine dimers is effected by recombination, which is mutagenic in strains of Escherichia coli having the wild type allele at the exr(Bs1) and exr (Bs2) locus, but is nonmutagenic in strains having mutational defects at this locus. Therefore, uv-induced mutations are actually recombination-induced mutations, produced as a consequence of inaccurate recombinational repair of secondary uv damage (gaps opposite pyrimidine dimers) in Exr^+ strains. In E. coli, most uv-induced mutations (i.e., recombination-induced mutations) are single-base substitutions, although a small fraction are frameshifts, possibly all of the single-base deletion type. Recombination, therefore, does not cause mutations in E. coli primarily by unequal exchange, but by the alteration of the pairing specificity of a single base. Preliminary evidence suggests that mutations induced by x-rays and by thymine starvation may also be largely due to errors in recombinational repair of gaps which cannot be repaired by simple repair synthesis. In the case of x-rays, recombinational repair probably occurs before the first post-irradiation replication. In some strains, recombination errors may also play an important part in spontaneous mutability. (auth)

34261 MAINTENANCE OF POLYGENIC AND ISOALLELIC VARIATION IN POPULATIONS. Mukai, Terumi (North Carolina State Univ., Raleigh). pp 293-308 of Proceedings of the XII International Congress of Genetics, Tokyo, Japan, August 19-28, 1968. Vol. 3. /Oshima, C. (ed.). Tokyo; Science Council of Japan (1969).

See CONF-680844-(Vol.3).

Speculations based on recent studies on polygenic variation (with respect to viability) suggest that overdominance (per locus) is not common in equilibrium populations, particularly those of Drosophila melanogaster and D. pseudoobscura although the manifestation of overdominance is possible under certain restricted conditions. Indeed it has been shown in a computer simulation study, using parameters established in laboratory experiments on spontaneous and x-radioinduced mutation rates of polygenes controlling viability, that the polygenic variation actually found among second chromosomes in equilibrium populations of D. melanogaster could be explained by an average of only 10 heterozygous loci per chromosome. Other recent studies have shown that numerous isozyme polymorphisms exist in D. pseudoobscura, D. ananassae, D. melanogaster, and other species. The proportions of polymorphic loci were estimated to be ca. 30%, 40-50%, and 54%, respectively. These two seemingly contradictory findings can be explained only if the isozyme variation does not make a significant contribution to the genetic load. This means that most, but not necessarily all, segregating isozyme loci in equilibrium populations involve neutral or near neutral isoalleles. Of the numerous mechanisms suggested for the maintenance of genetic variation, the following two are considered to be the most applicable under these conditions: 1. Frequency-dependent selection with neutrality of each genotype with respect to fitness in equilibrium populations, and 2. Neutral alleles with high mutation rates. In the latter case, it has been shown that the effective number of neutral alleles per locus is $4Ne\mu + 1$ where Ne is the effective population size, and μ stands for the mutation rate. (M.M.B.)

34262 MUTATION BREEDING. Swaminathan, Monkombu S. (Indian Agricultural Research Inst., New Delhi). pp 327-47 of Proceedings of the XII International Congress of Genetics, Tokyo, Japan, August 19-28, 1968. Vol. 3. /Oshima, C. (ed.). Tokyo; Science Council of Japan (1969).

See CONF-680844-(Vol.3).

Plant breeding all over the world has entered a new phase. There is increasing emphasis on the isolation of genotypes which respond to good agronomy and which have far superior and in some cases altogether new quality characteristics as related to nutrition and processing and cooking. The genetic diversity occurring in the existing populations of cultivated plants and their wild relatives is generally conditioned by the selection sieves-

both natural and human--through which the population has passed during its phylogenetic history. The changing selection norms of plant breeding provide great opportunities for exploiting the tools of mutation breeding for the development of genotypes suited to the new needs. The results of the research work done in this field during recent years amply support this view. Mutants with altogether new maturity and adaptation characteristics, better responsiveness to fertilizer application, greater ability to utilize sunlight, and better protein quantity and amino acid profile have been isolated and released as new varieties. In addition, induced variation has provided excellent breeding material, since the variability created is usually in an already improved and well-adapted genetic background. With the identification of potent chemical mutagens and with the growing understanding of the numerous parameters which influence sensitivity to mutagens, the scope for increasing the frequency and spectrum of mutations has widened. Though the spectrum can not yet be altered with assurance, ways are open for inducing specific mutations through action on repair mechanisms as well as by administering the treatments at different times during the S phase of DNA synthesis. The latter possibility has been demonstrated experimentally in barley. Systematic and macro-mutations are in many instances as valuable as micro-mutations in plant breeding. For example, the mutants with the characteristics of sub-species indica isolated in strains belonging to sub-species japonica of Oryza sativa are of immediate agricultural value in many indica rice areas. Whatever may be the direction of the mean of induced polygenic variation, scope for selection advance exists, in view of the increase in the additive genetic variance. Morphological markers associated with the synthesis of essential amino acids like lysine are being identified in mutation experiments and good prospects exist for improving the protein quality of the major cereals and grain legumes through mutation breeding. Similarly, altogether new types of morphological architecture and developmental rhythm can be introduced into crop plants cultivated in areas with a chronic moisture deficit, since in such areas human selection for a high yield potential has not been as intensive as in areas with enough water. Mutation research has thus widened the canvas of plant breeding and has provided the major hope of facing successfully the new needs of world agriculture. It would thus soon become an indispensable tool in breeding programme. (auth)

34263 CYTOLOGICAL EFFECT OF LASER RADIATION IN ALLIUM FISTULOSUM L. SPROUTS. Rodionova, V. V.; Tarasov, V. A. (Inst. for General Genetics, Moscow). Dokl. Akad. Nauk SSSR; 188: 692-3(21 Sep 1969). (In Russian).

In order to determine the specific biological effect of coherent monochromatic light as a function of wavelength, the action of laser radiation with wave lengths of 4880, 5682 and 106,000 Å on Allium fistulosum cells was investigated. The power level of the laser radiation was 1×10^{-2} to 1.2×10^{-2} J/cm^2. It was found that at 6328 Å irradiation of the sprouts at all but the lowest doses results in an increase of the chromosome aberrations; the dose dependence curve of their yield exhibited saturation. The data obtained with the 4880 Å radiation were similar to the dose dependence behavior with the 6328 Å wavelength radiation. This behavior may be due to the action of the premutation potential changes of chromosomes already present in the cells. Similar maxima have been reported in the literature for exposure to ultraviolet and x radiations. Exposure to the λ = 106,000 Å radiation did not cause any statistically important changes in the aberration yield. Thus, the laser irradiation does seem to affect the probability of injury to chromosomes. (TTT)

34264 MODIFICATION OF NUCLEOLAR EXPRESSION FOLLOWING LASER MICRO-IRRADIATION OF CHROMOSOMES. Berns, M. W.; Ohnuki, Y.; Rounds, D. E.; Olson, R. S. (Pasadena Foundation for Medical Research, Calif.). Exp. Cell Res.; 60: 133-8(Apr 1970).

An argon laser microbeam was used to irradiate the secondary constriction region (nucleolar organizer) of salamander lung cell chromosomes that had been photosensitized with acridine orange (AO). Irradiation of the secondary constriction caused a reduction in nucleolar number. The remaining nucleoli in the irradiated nuclei appeared to be larger than normal. A nucleolar compensation reaction was hypothesized. (auth)

34265 PHENOGENETICS OF THE EYELESS-DOMINANT MUTANT OF DROSOPHILA MELANOGASTER. I. DEVELOPMENT OF THE LETHAL LARVAE. Arking, Robert (Univ. of Kentucky, Lexington). J. Exp. Zool.; 171: 285-96(Jul 1969).

The nature of the causal mechanisms underlying the developmental arrest of the radioinduced lethal ey^D homozygotes was studied. The eyeless-dominant (ey^D) mutant originated as a single heterozygous male that appeared in the F_1 progeny of a group of genetically identical x-irradiated males. The phenocritical phase occurred at the onset of metamorphosis. Nonpupating larvae remained in the third instar for periods of time ranging up to 120 hr after their normal sibs had pupated. By this time they had either died as arrested third instar larvae or else underwent a delayed pupation and then died. No "fourth instar" larvae were observed. Those lethals that did pupate died at a mean gonadal developmental age of 20 to 36 hr. A distinctive syndrome of morphological abnormalities, characteristic of an aphasic development, was found in the nonenclosed pupae. The release of the neurosecretory substances in the lethals may be delayed for at least 36 hr following pupation. Injection of α-ecdysone enabled 94% of the nonpupating larvae, arrested at the third instar for 72 to 84 hr after their normal sibs had pupated, to resume development and enter the prepupal or pupal stages. The ey^D mutation most likely exerts its lethal effect by adversely affecting the ecdysone titer, thereby creating a hormonal imbalance with manifold effects on the developmental process. (BBB)

34266 MUTAGENIC MECHANISMS. Drake, John W. (Univ. of Illinois, Urbana). Annu. Rev. Genet.; 3: 247-60(1969).

Radioinduced and other forms of mutagenesis are reviewed. Studies of uv mutagenesis have revealed the key role of DNA repair processes. However, hardly any study has gone into the mechanism of formation of point mutations by ionizing radiations. Ultraviolet light induces both frameshift mutations and base pair substitutions in bacteriophages T4 and S13, in Escherichia coli, and probably in Neurospora. A few transversions are also induced. Deletions are readily induced in bacteria, but not in T4. Ultraviolet photoproducts in nucleic acids include the well-known cyclobutane pyrimidine dimers, a variety of less well-characterized pyrimidine dimers, dihydrothymine, cytosine hydrate, crosslinks between complementary chains, DNA-protein crosslinks mediated by cysteine, and others. Both the analogy with hydroxylamine, and the results of studies using an in vitro RNA polymerase system, suggested that the cytosine → thymine transitions were produced by cytosine hydrate; frameshift mutations seemed likely to be produced by pyrimidine dimers. However, only the dimers are repaired by photoreactivation, whereas base pair substitutions and frameshift mutations are both subject to photoreversal by white light. A method has been developed to produce thymine dimers in DNA without the concomitant production of cytosine hydrates. When T4 is treated in this manner, the same frameshift mutations and base pair substitutions appear as are induced by uv light. The resolution of this paradox has been provided by studies of uv mutagenesis in bacteria. A considerable body of literature has accumulated to document the close but complicated relation between uv mutagenesis and repair processes. Pyrimidine dimers lead to the formation of single-strand gaps in DNA, both during excision repair and during replication. The aberrant repair of these gaps then produces mutations. (257 references) (BBB)

34267 RADIOPROTECTIVE PROPERTIES OF ASCORBIC ACID. Selimbekova, D. D. Dokl. Akad. Nauk Azerb. SSR; 25: No. 6, 78-80(1969). (In Russian).

Radiation protection by ascorbic acid was studied in the cells of onion (Allium fistulosum) seeds and sprouts treated with 1×10^{-1} to 1×10^{-6} μg/ml of ascorbic acid and exposed to 100 and 1000 R γ radiation respectively. Tabulated data obtained indicated that the 17.7 ± 1.58% level of chromosome mutations was reduced to 12.6 ± 1.44 and 13.8 ± 1.18% as the result of the treatment with ascorbic acid with concentrations of 1×10^{-3} and 1×10^{-4} μg/ml. The best effect was observed with ascorbic acid concentration of 1×10^{-5} and 1×10^{-4} γ/ml. (R.V.J.)

34268 A KARYOLOGIC STUDY AT THE LATE STAGES OF AN ACUTE RADIATION DISEASE. Okladnikova, N. D. (Inst. of Biophysics, Moscow). Genetika; 6: No. 2, 152-60(Feb 1970). (In Russian).

A cytogenetic study was made on four patients who had suffered radiation damage from 7 to 10 yr ago as a result of the whole-body γ and neutron irradiation. The total dose was 270 to 980 "bars". The structural abnormalities of chromosomes were observed in the lymphocytes from the peripheral blood, the frequency of chromosomal aberrations being 0.01 to 0.06 per cell. Also, the tendency to polyploidy was found as well as the increased numbers of cells with endoreduplicated chromosomes and the decreased association of satellite chromosomes. There was no definite correlation of aberration frequency with the total dose. The combined study of bone marrow cells and cultures of the peripheral blood did not reveal any chromosomal aberrations in the bone marrow. (auth)

34269 RELATIONSHIP BETWEEN POLYPLOIDY AND RADIOSENSITIVITY AND THE KINETICS OF POST IRRADIATIVE RECOVERY IN BARLEY. Radu, Marica; Raicu, P. (Univ., Bucharest). Genetica; 12: 157-9(1968). (In Rumanian).

The relation between polyploidy and radiosensitivity in Hordeum vulgare was studied using a French variety of barley, Bonté (2n and 4n) and a Rumanian one, Cenad 396 (2n and 4n). Dry seeds, with moisture of 12 to 13% were irradiated with a radio-cobalt source in a total dose of 25,000 R. It was found that the chlorophyll mutation frequency showed an inverse relation with the ploidy level, and that a shift in their spectrum occurred; with a higher incidence in 2n plants of the albidum type ones, which are unviable. Cytogenetic studies of X_1 plants provided evidence that the frequency of chromosome aberrations per cell during meiosis increased with increasing ploidy, unlike the aberration frequency per chromosome, which ranged at quite equal values in the 2n and 4n plants. As to the X_2, a more rapid decrease in the aberration frequency per cell was found for the 4n plants, as compared to the 2n ones. As the greater radioresistance of the 4n plants resulted in a higher fertility too, it may be concluded, that, despite the equality between the frequency of aberration per chromosome in the 2n and 4n forms, a genetic compensation process due to the homologous genomes could account for the lower radiosensitivity of the autotetroploid plants. Finally, the kinetics of postirradiative recovery was studied in mitosis during 12 days from the beginning of germination, and evidence was obtained that, irrespective of the initial yield of chromosome aberrations, their elimination proceeds with a higher rate in autotetraploid plants, suggesting a more rapid recovery ability of these plants. (auth)

34270 INFLUENCE OF X-RAY DOSE AND TIME OF ITS DELIVERY IN VITRO ON THE YIELD OF CHROMOSOMAL ABERRATIONS IN THE PERIPHERAL BLOOD LYMPHOCYTES. Bajerska, Alina; Liniecki, Julian (Instytut Medycyny Pracy, Lodz, Poland). Int. J. Radiat. Biol.; 16: 467-81(1969).

The relation was studied between the x-ray dose and yield of chromosomal aberrations in human lymphocytes irradiated in vitro and examined in metaphase 51 hours after initiation of the culture. The doses ranged from 30 to 415 Rads, delivered at two dose-rates: ~110 and ~16 Rads/min. Frequency of the aberrations (y_1) versus dose (x) were described using two types of regression function: $y_1 = \alpha_1 x^{\beta_1} + c_1$ and $y_1 = a_1 x + a_2 x^2 + c_1$. At high dose-rate, the power function exponent for dicentric chromosomes of 1.23 ± 0.13 was observed; at the dose rate of 16 Rads/min the exponent was not significantly different from unity. In the quadratic equation, lowering of the dose-rate was followed by reduction in the contribution of the dose-square term roughly by an order of magnitude; a similar observation was made with respect to other aberrations (rings, acentric fragments and intercalary deletions). The effect of irradiation-time (from 3 up to 453 min) on the aberration yield after a constant dose of 301 Rads was studied. Beginning with 5 min, further stretching of the time did not affect the frequency of dicentrics and rings, but was accompanied by a significant reduction of the yield of intercalary deletions and acentrics. (auth) (UK)

34271 CYTOGENETICAL STUDY OF BONE-MARROW IN MAN AFTER A SINGLE LOCAL GAMMA-IRRADIATION: DOSE- AND TIME-RELATIONSHIPS. Pyatkin, E. K.; Dvoretskii, L. I.; Vorobev, A. I. (Inst. of Biophysics, Moscow). Int. J. Radiat. Biol.; 16: 535-43(1969).

Direct chromosome studies of bone-marrow cells were made in a control group of four tumor patients and in a group of 39 patients at different intervals of time (1 to 96 hours) after a single local irradiation with ^{60}Co gamma-rays at doses of 50, 100, 150, 200, and 250 Rads. The data obtained demonstrated that the frequency and type of chromosome aberrations are dependent on the time after irradiation. The most frequent aberrations induced in bone-marrow cells by gamma-rays are chromatid and chromosome fragments. It was shown that the yield of aberrant cells increases linearly with increase in dose. (auth) (UK)

34272 GAMMA-RAYS AND EMS-INDUCED MUTATIONS ON FLAX (LINUM USITATISSIMUM L.). Marki, A.; Biazu-Moresa, Maria (Biological Research Center, Cluj). Genetika; 6: No. 1, 24-8(Jan 1970). (In Russian).

The mutagenic effect of γ rays and EMS was studied on two varieties of flax, Concurrent and Raja. Dried seeds have been treated with 30 to 60 kR, or with EMS solutions of various concentrations for 12 and 24 hours. Treatment with EMS solution at a concentration of 1/100 ml even for 12 hours had a lethal effect upon both varieties of seeds. The total percentage of EMS-induced mutants was 2 to 3 times greater than that obtained by treatment with γ rays; the frequency of the chlorophyll mutants induced by EMS treatment was 5 to 10 times higher for Concurrent and 3 to 5 times higher for Raja compared with irradiation. The frequency of the chlorophyll mutants differed significantly between the two varieties but only when EMS was used as mutagenic agent (P% = 2.7). The various EMS concentrations used seemingly had no marked effect on the mutagen spectrum. It is suggested that the differences observed in the mutation spectrum induced by γ rays and EMS are due to the specific action of the mutagenic agents. Some of the mutants (albostriata, alboxantha, caespitosa, torsus, heterostylious, polycarpellic-apocarpic, cruciata, mutants with closed blossom, mutants with waved stem) found have not been recorded by Linum usitatissimum L. or even by the Linum genus. (auth)

34273 THE EFFECTS OF ONTOGENETIC STAGE AND RADIATION DOSE ON THE FREQUENCY OF MUTATIONS OF THE SU GENE IN ZEA MAYS L. Cerny, J. (Univ. of Agriculture, Prague). Genet. Slechteni; 6: 1-6(Feb 1970). (In Czech).

The influence of the ontogenetic stage and the influence of chronic and acute irradiation of pollen on the frequency of mutations of the Su gene in maize (Zea mays L.) was investigated. Mutations of the Su gene were induced by chronic irradiation of plants of the line of a haploid tester with a starch endosperm (Su) in a gamma-field and with an acute irradiation of pollen with doses of 500 R, 1,000 R and 1,500 R. The frequency of mutations of the Su gene was determined according to the occurrence of the sugar endosperm (su su) in the Fo generation of the ♀ crossbred "Golden Bantam" (su su) × ♂ of the irradiated line of the haploid tester (Su Su or Su). A maximum radiosensitivity in the course of the ontogenetic development, estimated according to the frequency of mutations of the Su gene, was found in the IXth stage of development after the forming of pollen grains in the anthers. Chronic irradiation of maize anthers with a dose having an intensity of radiation of 0.271 R/min. significantly increased the frequency of mutations of the Su gene in comparison with an acute irradiation with doses of from 500 to 1,500 R with an intensity ranging from 38 to 60 R/min. All applied variants of chronic and acute irradiation significantly increased the frequency of mutations of the Su gene compared with the spontaneous process of mutation. (auth)

34274 ISOGENICITY IN PARTHENOGENETIC STRAINS OF DROSOPHILA MERCATORUM. Carson, Hampton L.; Wei, Irene Y.; Niederkorn, John A. Jr. (Washington Univ., St. Louis). Genetics; 63: 619-28(Nov 1969).

Using one natural and three recessive mutants induced by x rays, inheritance in both bisexual and unisexual strains of D. mercatorum has been studied. The mutants spotless and white are sex-linked and show about 34% recombination in bisexual crosses. A virgin female heterozygous for these mutants produces impaternate diploid daughters in essentially gametic ratios. The same is true for the autosomal mutants. Wild-type females known to be heterozygous at a locus, therefore, produce wild-type and mutant diploid daughters in essentially a 1:1 ratio. When tested, approximately 94% of the wild-type daughters proved to be homozygous wild type. The remaining 6% are heterozygous at one or more loci.—It is concluded that the two meiotic divisions of virgin females proceed normally, producing, as in other Drosophila, four haploid nuclei in the cytoplasm of the egg. Diploidy appears to be restored in more than 90% of the eggs by post-meiotic nuclear doubling of a single meiotic product producing an isogenic diploid organism. The 6% of the impaternate wild-type offspring which show heterozygosity are judged to have arisen from the fusion of two of the four meiotic products in the manner known to occur in D. parthenogenetica. Accordingly, it is concluded that the majority of impaternate stocks of D. mercatorum are essentially isogenic. The implications of these findings are briefly discussed. (auth)

34275 EFFECTS OF TEMPERATURE ON THE INDUCTION OF SOMATIC MUTATION BY ACUTE GAMMA RADIATION EXPOSURES IN RICE PLANTS. Yamagata, Hirotada; Fujimoto, Mitsuhiro (Kyoto Univ.). Bull. Inst. Chem. Res., Kyoto Univ.; 48: 72-7(Jan 1970).

Radiation damage and especially somatic mutation induced by gamma irradiation were studied with special attention to the effects of temperature. Potted plants of rice variety Gimbōzu were exposed to 4 to 12 kR of gamma rays at various stages of plant development in 1968. Plants derived from Gimbōzu and heterozygous for a color gene were exposed to 4 to 20 kR of gamma rays at tillering stage in 1969. Exposures at every developmental stage were conducted at 10°, 20° and 30°C simultaneously. Radiation damages in several characters and somatic mutations were examined in both years and in 1969, respectively. Experimental results indicated remarkable effects of temperature on both the degree of damage and the frequency of mutation. Considerations were made on relationship between dose effect and temperature and on somatic mutation. The 2000-Curie cobalt-60 gamma-ray irradiation facility for biological studies was used for the study. (auth)

34276 STUDIES OF RADIOINDUCED CHROMOSOME ABERRATION. Teodosiu, T.; Georgescu, I. Rev. Sanit. Mil.; 72: 691-5(Nov-Dec 1969). (In Rumanian).

Study of radiation-induced modifications helps to evaluate le-

sions at the cellular level. Chromosome aberrations are of special importance in this respect. They are examined by cytogenic analysis. The number and the morphological type of the chromosome aberrations determine the survival or death of the cells. Data concerning the mechanism of chromosome aberration obtained with other cell cultures were found to be applicable for human cells. However, analysis of in-vitro radioinduced aberrations is difficult because the cells must be examined during the first post-irradiation division. Use of lymphocyte culture makes it possible to make such observations, to estimate the cell cycle in which the cells were exposed to radiation and to evaluate the relation between dose and radioinduced lesions. The data indicated that chromosome aberrations may be the chief factor in leukemia. Delayed effects in humans include among others premature aging; this is probably due to the accumulation of aberrations in organs with reduced or absent mitotic activity. (TTT)

34277 HETEROSIS OF PLANT HEIGHT AND OTHER CHARACTERS IN CROSSES OF MUTAGEN-INDUCED AND BACKCROSS-BRED SEMIDWARF WHEAT LINES. Ramirez-A, Ingacio. Pullman, Wash.; Washington State Univ. (1969). 176p.

Thesis.

Some relationships between adult plant height and grain yield were investigated in winter wheat (Triticum aestivum L. em. Thell.) via a combining ability analysis of plant height components and of yield and yield components, using the F_1 generation of a diallel cross among isogenic lines of the backcross Norin 10/Brevor-14//6*Burt and gamma-ray induced mutants of the variety Burt (CI 12696). Parents representing very short (VS), semishort (SS), and standard plant height (T) were chosen for this study. In addition, test-cross experiments using the tall variety Itana (CI 12933) and the semidwarf wheat Selection 101 (CI 13483) were carried on with parents belonging to different sources of semidwarfing genes on a common Burt background: Norin 10/Brevor-14//6*Burt, Suwon 92/4*Burt, Tom Thumb/4*Burt, and Burt mutants with parents at five different levels of plant height—very short (VS), short (S), semi-short (SS), semitall (ST), and tall (T). The diallel analysis indicated that the semidwarfing genes from the Norin 10/Brevor-14/6*Burt parents reduced the F_1 plant height in crosses with tall parents, more effectively than the induced straw-shortening factors present in the Burt mutants. The VS and SS isogenic parents were the most efficient for maintaining a short F_1 plant stature phenotype. Positive and negative F_1 heterosis and heterobeltiosis for plant height and internode lengths were observed but no dominance or semi-dominance was detected for these traits among the genotypes tested. The crosses involving the tall parents produced high-yielding F_1 progenies and a positive relationship was detected between tallness and yield in the genotypes examined. The isogenic parents had lower yield than the mutants and none of the F_1 hybrids yielded more than the highest yielding tall mutant parent. Twelve of 15 F_1 hybrids showed heterosis for yield but only two cases were significant; no positive significant heterobeltiosis was observed for this trait. Number of kernels per spike and, especially, kernel weight were the main yield components. The genotypic variability observed for yield and plant height was associated to a higher degree with highly significant GCA effects rather than with SCA effects indicating that additive gene action was more important than dominance gene action in controlling the inheritance of plant height and yield in the germplasm examined. Data on GCA and SCA estimates suggested that genotypic variability for yield due to genes behaving both additively and in a dominant manner and in an additive manner for plant height had been induced by mutation in the Burt germplasm. The test-cross experiments showed that only the VS Tom Thumb/4* Burt parent had a gene or genes that exhibited dominance or semi-dominance for short culm height in crosses involving tall parents. Data on straw/grain ratios indicated that the parents within the Suwon 92/4*Burt and Burt mutant sources had the lowest, more efficient straw/grain ratios and crosses involving these parents produced the F_1 hybrids with the lowest ratios relative to the F_1's derived from crosses with the other semidwarfing gene sources. (TSS) (Diss. Abstr.)

34278 EFFECT OF X RAY RADIATION ON THE PROTEOLYTIC AND ACID-FORMING ABILITY OF CERTAIN TYPES OF LACTATE ROD-SHAPED BACTERIA. Dilanyan, Z. Kh.; Arutyunyan, R. K.; Makaryan, K. V.; Akopyan, A. A. (Erevan Veterinary Inst.). Biol. Zh. Arm.; 22: No. 9, 29-33(Sep 1969). (In Russian).

X-ray doses of 36,000 and 54,000 R were given to 34 strains of Lactobacterium (21 strains belonging to L. helveticum, 8 to L. bulgaricum, 3 to L. acidophilum and 2 to L. casei). The acid formed by the irradiated microbes was determined by caustic titration with a blank titration on the feed medium containing no microbes. The density of lactic acid clumping was determined by a consistency meter as a measure of proteolytic activity. Taste and smell were determined organoleptically. Seven mutants were found to be more active by 35 to 81% in acid-forming ability than the unirradiated strains. About 15 radiomutants were found to maintain high proteolytic activity after repeated inoculation of the medium by a factor of 1.7 to 8.5 greater than the unirradiated strains. The greatest increase in proteolytic activity was observed in strains with a relatively low or average activity before irradiation. The taste and odor of the fermented products were normal. These strains of bacteria can be recommended for practical use. (TTT)

34279 EFFECT OF X RAY IRRADIATION ON THE MUTAGENICITY OF INITIAL WHEAT PLANT GROWTH IN THE SECOND GENERATION (M_2). Babayan, R. S. (Inst. of Experimental Biology, Erevan). Biol. Zh. Arm.; 22: No. 11, 74-7 (Nov 1969). (In Russian).

Second-generation (M_2) seeds of three winter wheats (Triticum aestivum var. erithrospermum, Tr. aestivum var. turcicum, and Tr. compactum var. erinaceum) were given x-ray doses from 5 to 20 kR. The length and dry weight of 7- to 12-day shoots were determined. The results of the experiments showed that the length of the shoots and plant weight from x-irradiated seeds varied over wider limits as compared to unirradiated controls. The dispersion at a 20 kR dose was greater as compared to a 5 kR dose. The differences between varieties were within the experimental error. The non-uniformity in initial growth was increased in the progeny of irradiated wheat seeds. This behavior is genetic in nature and was caused by the effect of radiation. It may be possible to use this test as an indicator of the genetic effect of radiation. (TTT)

34280 AGE EFFECTS, LOSS OF SPERM AND RANDOM VERSUS NONRANDOM CHROMOSOME BREAKAGE IN X-IRRADIATED DROSOPHILA MELANOGASTER MALES. Raka, Cathryn Teresa Crowley. Providence; Brown Univ. (1968). 91p.

Thesis.

Experiments were performed to measure age effects on the brood patterns produced by groups of previously unmated, aged Drosophila melanogaster males. In the present experiments the brood patterns represented the frequencies of autosomal translocations and sex-linked, recessive lethals occurring in six consecutive, two-day broods. It was found that with the exception of a significantly larger number of translocations recovered in brood 5, the brood patterns of x-rayed (4000 R) 20 and 26 day old males were not significantly different from those produced by males x-rayed (4000 R) at 4 days of age. The brood patterns produced by previously unmated 20 and 26 day old males x-rayed with two doses of 4000 R, once at 4 days and again at 20 and 26 days respectively, were not significantly different from those of younger males. Failure to find brood patterns in those groups of older males which reflected an interaction of the second dose with the first dose suggested that germ cells present at the first dose (given at 4 days of age) had been lost by the time the second dose was delivered. Further evidence for loss of sperm in unmated males was obtained by observing the frequencies of autosomal translocations and sex-linked, recessive lethals in six, consecutive, two-day broods in groups of males held, unmated, for varying intervals following 4000 R of x-rays before brooding. In males held as long as 16 and 22 days following x-ray, it was observed that the frequencies of translocations and lethals were significantly less than those of males brooded immediately after x-ray. Another source of evidence for loss of sperm in unmated males was obtained by testing a large number of translocations recovered from two males held 11 days post-x-rays before brooding. It was found that all the translocations derived from a given P1 male were the same with respect to breakpoint indicating: that they were part of a cluster, therefore, derived from a single translocation which occurred in a cell that was premeiotic at x-ray or, that they were due to a number of nonrandom breaks induced in the chromosomes of cells that were postmeiotic and meiotic at the time of x-ray. Additional evidence that these translocations were derived from breaks induced in cells which were premeiotic at x-ray was provided by recovering autosomal translocations from x-rayed (4000 R) groups of 7 and 20 day old males which were tested against each other. It was found: that the chromosome breaks recovered were randomly distributed and, that individual P1 males with few exceptions did not have sons carrying the same translocation with respect to breakpoint. Thus, for a large number (cluster) of translocations with the same breakpoint to be recovered from a given P1 male, it appeared more likely for it to have arisen in a cell which was premeiotic at the time of x-ray. (Diss. Abstr.) (TSS)

34281 IMMUNOFLUORESCENT INVESTIGATIONS OF SEROLOGICAL HOMOGENEITY OF Cl. PERFRINGENS AND ITS RADIATION MUTANTS. Pasichnik, A. M.; Tulina, G. G.; Kishko,

Ya. G. Mikrobiol. Zh.; 30: 126-9(Mar-Apr 1968). (In Ukrainian).

By an immunofluorescent indirect test serological homogeneity was studied of the initial strain of perfringens bacteria and their radiation mutants obtained under the effect of fast neutrons. It is shown that an intensive specific fluorescence took place in case of a high toxicogenic mutant and a weak one with an atoxicogenic mutant. A common antigen of the initial strain and mutants is localized inside a cell and in the membrane of the bacteria as well as on their poles. (auth)

34282 ON THE CALCULATION OF HUMAN MUTATION RATES FROM CHANGES IN SEX RATIO. Traut, H. (Univ., Muenster, Ger.). Ann. Hum. Genet.; 33: 45-52(1969).

A method for evaluation of human mutation rates from qualitative studies of sex ratios of children of parents whose gonads were exposed to ionizing irradiation was discussed. The derivation of formulae to estimate recessive sex-linked lethal mutations in males and females was presented. The method demonstrated also was suitable to calculate the rate of sex-linked recessive lethals induced in the germ cells of the grandmother. The incidence of dominant sex-linked lethal factors was discussed. The major disadvantage of the calculation method presented was that the absolute numbers on which the calculations were based were far too small to yield sufficiently narrow confidence intervals. The numbers of children required for this purpose depended on the mutation rate and ranged from ~10^4 for very high mutation rates to ~10^8 for low mutation rates. However, it was believed that large numbers would be available later, since it seemed likely that more and more people whose gonads were exposed to medical ionizing irradiation will have children afterwards. The radiation-induced mutation rate obtained in studies on sex ratio shifts among the children of survivors of the atomic bombing in Japan was recalculated from changes in sex ratio. On the basis of the formulae derived, it was estimated that the mutation rate had been underestimated by a factor of 4. The correct rate of recessive sex-linked lethal mutations induced in oocytes by irradiation with 100 rep would be ~0.024. The per locus mutation rate was not calculated, since the number of loci on the human X chromosome was not known well enough. (BBB)

34283 CONDITIONS FOR SOIL NUTRITION OF PLANTS IN M_1 AND VARIATIONS IN M_2 UNDER TREATMENT OF BARLEY WITH γ-RAYS AND SOME CHEMICAL MUTAGENS. Batygin, N. F.; Pitirimova, M. A. (Agrophysical Research Inst., Leningrad). Genetika; 6: No. 2, 34-9(Feb 1970). (In Russian).

The influence of the conditions for plant M_1 nutrition on genetic effects in M_2 is discussed. It is shown that in the case of excessive nutrition the number of similar mutations is less than in the case of normal nutrition. (auth)

34284 RADIATION-INDUCED RESISTANCE TO ROOT-KNOT NEMATODES IN KOREAN LESPEDEZA. Offutt, M. S.; Riggs, R. D. (Univ. of Arkansas, Fayetteville). Crop Sci.; 10: 49-50 (Jan-Feb 1970).

Eighty-three cultivars and strains of annual lespedeza, Lespedeza stipulacea Maxim. and L. striata (Thunb.) H & A., 77 of which were irradiated L. stipulacea strains, were evaluated for resistance to two of the most prevalent forms of root-knot nematodes (Meloidogyne incognita A and M. incognita B). Climax, Kobe, Korean, Summit, and strain 29a were scored as susceptible, and Rowan was scored as moderately resistant to each of these two forms of root-knot nematodes. Seventeen percent of the 77 irradiated strains originating from strain 29a were scored as highly resistant to M. incognita A, 12% were scored as highly resistant to M. incognita B, and 9% were scored as highly resistant to both of these forms of root-knot nematodes. In this study, 57% of the irradiated L. stipulacea strains had a significantly higher level of resistance to M. incognita A and 65% had a significantly higher level of resistance to M. incognita B than the check strain 29a. Approximately 50% of the irradiated strains also were scored as either equal or superior in resistance to both M. incognita A and M. incognita B in comparison with the moderately resistant cultivar Rowan. Thus, through the use of irradiation, a new source of L. stipulacea germ plasm with a high level of resistance to these two forms of root-knot nematodes is now available for improvement of this species. (auth)

34285 CYTOGENETIC ANALYSIS OF BONE MARROW IN PATIENTS AFTER LOCAL IRRADIATION. Zhantaeva, R. K. Tr. Kaz. Nauch.-Issled. Inst. Onkol. Radiol.; 6: 105-7(1969). (In Russian).

Chromosome aberrations were not found in bone marrow of unirradiated people. Following irradiation, chromosome aberrations were found in the bone marrow in proportion to radiation dose. Numbers of chromosome aberrations and rearrangements were correlated with radiation doses of 100, 300, and 500 rad. (auth)

34286 EFFECT OF FRACTIONATED IRRADIATION UPON CELLS OF EMBRYONAL FIBROBLASTS IN TISSUE CULTURE. Bigaliev, A. B.; Lyubimova, T. P. (Inst. of General Genetics, Moscow). Tr. Kaz. Nauch.-Issled. Inst. Onkol. Radiol.; 6: 274-8(1969). (In Russian).

Effects of variations in the ratio of the first and second radiation dose fractions and administration of thiourea on cultured fibroblasts were studied. The role of the intracellular system in radioinduced injuries to chromosomes was also investigated. A relationship between mitotic phase and the ratio of the first and second dose fractions was observed. (H.L.W.)

34287 REPAIR DEFICIENCY IN A BACTERIAL MUTANT DEFECTIVE IN DNA POLYMERASE. Kanner, Lee; Hanawalt, Philip (Stanford Univ., Calif.). Biochem. Biophys. Res. Commun.; 39: 149-55(8 Apr 1970).

The effect of ultraviolet irradiation (uv) was studied in Escherichia coli K12 strain W3110 pol+, and in its derivative, W3110 polA1, which lacks appreciable DNA-polymerase activity in extracts. The polymeraseless derivative appears to be deficient in some step in the excision-repair process although not totally lacking in repair capacity, since: it is more uv sensitive than the parent strain, yet less uv sensitive than an excision-deficient K12 strain, AB2500; it exhibits a lower single-strand DNA molecular weight than the parent strain during the growth period following uv irradiation. (auth)

34288 CHROMOSOMAL DAMAGE IN CHINESE HAMSTER CELLS GROWN IN UV-IRRADIATED MEDIUM. Antoshechkin, A. G. (Inst. of Space Research, Moscow). Photochem. Photobiol.; 11: 49-52(Jan 1970).

Data have been published which indicate that under uv-irradiation of some amino acids the injury of one of them depends to some extent on the presence of another one. Thus Meybeck and Meybeck propose a selective mechanism for excitation energy transfer from the phenyl group to the adjacent amino acid residue in the polypeptide chain. Dose has shown that under uv-irradiation cystine is injured more in the presence of tryptophan. Azizova has discovered the photosensitized radical formation of aliphatic amino acids in the presence of aromatic amino acids under uv-irradiation of frozen aqueous solutions. This phenomenon is more distinctly observed at temperatures from –196° till –110°C. As the temperature of frozen solutions increases during uv-irradiation the observed effect is diminished, and at 0° it completely vanishes. It is interesting to know whether the conjugate reactions of that kind occur at the usual conditions (in unfrozen solutions) and whether they can have any biological significance. Stone et al. have been shown that the uv-irradiation of nutrient medium (of unknown chemical composition) results in the occurrence of mutations in bacteria. In the present work, uv-irradiation of synthetic nutrient medium was carried out and the extent of chromosomal damage to mammalian cells growing in this medium was recorded. By the uv-irradiation of separate components of the medium in different combinations it has been discovered that amino acids absorbing and non-absorbing uv-quanta with $\lambda = 254$ nm interact at the moment of irradiation of the mixture of their solutions at room temperature. (auth) (UK)

34289 THE RELATION OF INTERPHASE CHROMOSOME VOLUME (ICV) TO AN ESTIMATED ACTUAL CHROMOSOME VOLUME. Conger, A. D. (Temple Univ., Philadelphia). Int. J. Radiat. Biol.; 17: 381-4(1970).

A method is described of obtaining estimates of the actual fraction of nuclear volume that is chromosomal. An attempt is made to correlate the actual chromosome volume with the radiosensitivity of various radiotaxons. (UK)

34290 CHROMOSOME MUTATIONS INDUCED BY SPACE FLIGHT FACTORS (SFF) IN BARLEY SEEDS DURING THE FLIGHT OF THE AUTOMATIC STATIONS "ZOND-5" AND "ZOND-6" AROUND THE MOON. Nuzhdin, N. I.; Dozortseva, R. L.; Pastushenko-Strelets, N. A.; Samokhvalova, N. S.; Chudinovskaya, G. A. (Inst. of Biological Physics, Moscow). Zh. Obshch. Biol.; 31: 72-83(Jan-Feb 1970). (In Russian).

There were barley seeds of two varieties: Odessky-17 and Moscovsky-121 on the automatic stations "Zond-5" and "Zond-6" during their flight round the moon. The seeds of OD-17 were in two states: dormant and resting ones. The seeds of M-121 were of two strains: Estonian, characterized by a high radiosensitivity, and Pamir, radio-resistant. Experimental and control seeds were not irradiated, irradiated before or after the flight once or two times. In the latter case, one half of a dose was given before the flight and the other one after it. There were two control series: one stayed in Moscow, the other was taken to the cosmoport and

back by plane. A cytological study has shown significant differences between the experimental and control series in the amount of aberrant cells (chromosome mutations). Out of 25 experimental series in 19 the percentage of aberrant cells differed from that in the control and in 6 the differences were insignificant. These latter series belonged to the same type: seeds were germinated just after breaking the dormant state. An analysis of the material has shown that SFF caused chromosomal damages in these seeds as well. However, owing to the physiological peculiarities of the seeds in question, the primary damages in cells of their seedings were not manifest. The genetic effect of the combined influence of SFF and γ-irradiation depends on the physiological state of irradiated material and the dose of irradiation. The dormant state, high radioresistance of seeds, low dose of irradiation call forth the additive effect of the combined influence of SFF and γ-irradiation. The resting state or high radiosensitivity of seeds under the combined influence of the said factors provide a sharp increase in the effectiveness of SFF. The additive and sensitizing effects of irradiation and SFF manifest themselves in seeds on the same space apparatus depending on the above conditions. (auth)

34291 EFFECT OF COMBINED ACTION OF GAMMA RAYS AND DIETHYLSULPHATE ON GARDEN PEAS. Mekhandzhiev, Amanas (Inst. of Genetics and Plant Breeding, Sofia). Genet. Selektsiya; 2: No. 1, 39-53(1969). (In Bulgarian).

Results are reported from studies on the effect of combined action of gamma rays and diethylsulphate on garden peas in connection with a successive mutagenic treatment. Dry seeds of the Sofia 135 garden pea variety were treated with diethylsulfate 0.2% for 12 hours and then washed and radiated with ^{60}Co in a dose of 10 kR. Reciprocally, seeds were first radiated and afterwards treated with the chemical mutagen in the same way as in the first combination. In order to determine the influence of the two mutagens and their combinations, chromosome aberrations, survival of plants in M_1, and chlorophyl mutations in M_2 were recorded. The investigations give evidences for the following references: 1. Pea seed treatment with medium concentrated diethylsulfate before or after γ irradiation reduces the percentage of chromosome aberrations in the meristematic cells of the rootlets at the time of first mitotic division. This favorably affects the growth and development of M_1 plants. Chromosome disturbances diminish significantly when the chemical mutagen acts after radiation. 2. Combined action of γ rays and diethylsulfate considerably enhances the frequency and range of chlorophyll mutations in M_2. In this respect the following dependences were found: a) Combining both mutagens affects the frequency of occurrence of chlorophyll mutations. Highest percentage of chlorophyll mutations may be obtained when diethylsulfate treatment follows radiation. Reciprocal treatment, however, results in highest percentage of progenies with chlorophyll mutations. A positive correlation is found between the percentage of plants with morphological changes in M_1 and frequency of progenies with chlorophyll mutations in M2; b) Combining also exerts an influence on the range of chlorophyll mutations. This range is wider when diethylsulfate acts after γ radiation; c) Gamma rays alone show a slight mutagenic effect in relation to chlorophyll mutations while their use in combination with the chemical mutagen raises several times the mutation frequency. 3. Because of considerably decreased number of chromosome aberrations, a higher percentage of plants survive in M_1 and a greater frequency of chlorophyll mutations occurred, the combination is more promising when the chemical mutagen acts immediately after γ irradiation. (auth)

34292 RADIO-INDUCED MUTANTS OF THE SCHMIDT-RUPPIN STRAIN OF ROUS SARCOMA VIRUS. Golde, Alice (Faculte des Sciences, Orsay, France). Virology; 40: 1022-9 (Apr 1970).

The action of γ-rays on the virus-producing and oncogenic capacities of clonal SR-RSV were studied in order to specify the relationships between these two functions. Two kinds of mutants were obtained from viral suspensions heavily irradiated: virions still able to convert cells, but unable to give rise to progeny (sterile oncogenic virions), identified by their ability to produce nonproducing transformed cells; these cells, not activable by superinfection with RAV, were cancerous since they induced graft tumors on the egg CAM; virions unable to transform C/O chick embryo cells, i.e., having lost the oncogenic capacity, but able to replicate at high titer and to induce a high level of gs antigen. Furthermore, this mutant, called the NT (γ) virus, confers to the cells a high resistance against challenge RSV belonging to the subgroups B and D of avian oncogenic viruses, and a slight resistance against challenge RSV belonging to the subgroup A. The meaning of these facts is discussed. Present results support the previous hypothesis of the independence of oncogenic and virus-producing capacities. (auth)

34293 THE COMBINED EFFECTS OF EMS AND γ RADIATION ON THE MUTABILITY OF BARLEY. Habetinek, J. (Univ. of Agriculture, Prague). Genet. Slechteni; 6: 7-10(Feb 1970). (In Czech).

In the case of combined action of gamma rays and EMS on the grains of two-row summer barley a synergistic action of both mutagens was observed. The chief criterion of the mutagenic effect was the determination of the frequency of chlorophyll mutations. (auth)

34294 STUDIES OF INDUCED MUTATIONS IN PEAS. XXIII. THE INFLUENCE OF TREATMENT CONDITIONS ON THE EFFECTS OF ETHYLMETHANESULFONATE SEED-TREATMENT. Gelin, O. (Weibullsholm Plant Breeding Inst., Landskrona, Sweden). Hereditas; 59: 263-79(1968).

Some results are presented from a series of experiments comprising seed-treatments with ethylmethanesulfonate (EMS) intended to elucidate mainly the temperature effect. The effects of seed-treatments of higher plants with β- and γ-rays and with chemical mutagens are strongly influenced by the conditions outside and inside the object. Certain conditions like dosage, temperature and time are factors more or less directly governing the chemical processes involved in the action of the agent. The germination and growth inhibition, sterility and mutation can be independently varied. This is important for several reasons. From a theoretical point of view it opens possibilities of tracing different points and ways of action for an agent, if only the effects can be determined by means of measurable quantities. The effect of temperature on seed-treatments with EMS in peas were studied. A strong influence of temperature on the characteristics such as germination, growth and lead-spotting were found. Generally, both toxicity and mutagenicity were found to increase with increasing temperature. It is concluded, however, that to obtain optimal treatment conditions, it is insufficient to consider only temperature and concentration. To obtain the optimal result, all conditions must be taken into consideration, such as pre- and post-treatments, time, temperature, hydrogen-ion concentration, concentration of the mutagen, etc. (auth) (Sweden)

Health Physics and Safety

Radioactive Contamination and Decontamination

Refer also to abstracts 34016, 34183, 34188, 34189, 34192–34194, 34198–34229, 34232, 34233, 34235, 34236, 34343, and 34385.

34295 (BNWL-1050(Pt.1), pp 5.3-4) REMOVAL OF FIRMLY BOUND PROMETHIUM FROM THE RAT. Smith, V. H. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

From Pacific Northwest Laboratory annual report for 1968 to the USAEC Division of Biology and Medicine. Vol. I. Life sciences. Pt. 1. Biological sciences.

Repetitive treatments with chelons (DTPA, EDTA, and TTHA) initiated 24 days after radionuclide injection, were quite effective in reducing tissue concentrations of ^{147}Pm in the rat. Bone burdens were reduced to half those in nontreated animals. Of the agents tested, DTPA was the agent of choice for removal of ^{147}Pm, as well as for the prevention of its deposition. (C.H.)

34296 (BNWL-1050(Pt.1), pp 5.5-8) EFFECT OF PROMETHIUM CONCENTRATION ON DEPOSITION AND REMOVAL IN THE RAT. Smith, V. H. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

From Pacific Northwest Laboratory annual report for 1968 to the USAEC Division of Biology and Medicine. Vol. I. Life sciences. Pt. 1. Biological sciences.

An inverse mass effect on the deposition of promethium in the skeleton but not in soft tissues of rats was found. As a consequence, tracer experiments with ^{143}Pm may tend to overestimate the bone deposition to be anticipated from accidental exposures to ^{147}Pm and might lead to erroneous interpretations of excretion curves. Therapy by prompt treatment with DTPA is effective over a wide range of chelon to metal ratios. When DTPA treatment is delayed for 48 hr, promethium is removed principally from the liver, though significant removal from the skeleton also occurs. (auth)

34297 (BNWL-1050(Pt.1), pp 5.8-11) PROMETHIUM REMOVAL STUDIES IN MINIATURE SWINE. Smith, V. H.; Amster, R. L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

From Pacific Northwest Laboratory annual report for 1968 to the USAEC Division of Biology and Medicine. Vol. I. Life sciences. Pt. 1. Biological sciences.

Treatment with DTPA, commencing one and 28 days after the intravenous administration of $^{147,148m}PmCl_3$ to swine left about 12 and 38% of the injected dose still present at 100 days compared to 88% in nontreated animals. When the onset of the course of treatments was delayed until 78 days there was 44% retention after 155 days. (auth)

34298 (BNWL-1050(Pt.1), pp 5.11-14) REMOVAL OF INHALED $^{239}PuO_2$ FROM RATS. Dilley, J. V. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

From Pacific Northwest Laboratory annual report for 1968 to the USAEC Division of Biology and Medicine. Vol. I. Life sciences. Pt. 1. Biological sciences.

The most effective agents tested for removal of inhaled $^{239}PuO_2$ from rats were chlorothiazide (Diuril), ammonium chloride with Carbopol 941, Phenergan, and Halotestin. Lung burdens of inhaled $^{239}PuO_2$ were reduced by as much as 40% over a 21-day treatment period. (auth)

34299 (BNWL-1050(Pt.1), pp 5.14-17) EFFECT OF DTPA ON INHALED $^{239}PuF_4$ IN BEAGLES. Dilley, J. V. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

From Pacific Northwest Laboratory annual report for 1968 to the USAEC Division of Biology and Medicine. Vol. I. Life sciences. Pt. 1. Biological sciences.

DTPA had no effect on the retention, distribution, or excretion of inhaled $^{239}PuF_4$ in beagle dogs treated over a 12-week postexposure period. The behavior of inhaled $^{239}PuF_4$ in beagle dogs was very similar to that of $^{239}PuO_2$. (auth)

34300 (BNWL-1050(Pt.1), pp 5.18-19) REMOVAL OF INHALED $^{239}PuO_2$ BY LUNG WASHING. Sanders, C. L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

From Pacific Northwest Laboratory annual report for 1968 to the USAEC Division of Biology and Medicine. Vol. I. Life sciences. Pt. 1. Biological sciences.

Over half of the $^{239}PuO_2$ particles deposited by inhalation in the rat lung could be removed by serial washing with saline. The amount removed depended on the amount initially deposited and the time since inhalation. (auth)

34301 (BNWL-1050(Pt.1), pp 5.19-21) EFFECT OF ELECTRO-AEROSOL INHALATION ON PULMONARY CLEARANCE OF $^{239}PuO_2$ IN RATS. Wehner, A. P. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

From Pacific Northwest Laboratory annual report for 1968 to the USAEC Division of Biology and Medicine. Vol. I. Life sciences. Pt. 1. Biological sciences.

Rats that had inhaled $^{239}PuO_2$ were subsequently exposed to a negatively charged aerosol, sacrificed, and lungs and trachea analyzed for plutonium. The groups treated with electro-aerosols generally retained less plutonium than their controls. (auth)

34302 (LF-41, pp 214-20) PULMONARY LAVAGE WITH SALINE AND DTPA PLUS SALINE AS AT THERAPEUTIC MEASURE FOR BEAGLE DOGS EXPOSED TO A ^{144}Ce-LABELED CsCl AEROSOL. Pfleger, R. C.; McClellan, R. O.; Harvey, J. W.; Sesline, D. H. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.).

The use of bronchopulmonary lavage with an isotonic saline solution or a diethylenetriamine pentaacetic acid (DTPA) aqueous solution for the removal of inhaled radionuclides from the lung is described. Thirteen beagle dogs were exposed via inhalation to a ^{144}Ce-labeled CsCl aerosol. The left lungs of 8 dogs were lavaged; 2 with saline and 2 with DTPA on day 0 (the day of exposure) and day 5 post-exposure; 1 with saline and 1 with DTPA on day 0 only; and 1 with saline and 1 with DTPA on day 5 only. Five dogs received no lavage treatment. The control dogs excreted 7% of the initial ^{144}Ce lung burden (ILB) in the urine; 93% was recovered in the tissues (25% in lung, 38% in liver, 26% in skeleton and 4% in other tissues) at the time of sacrifice (28 days post-inhalation exposure). The animals lavaged with saline on days 0 and 5, and day 0 demonstrated that 11% of the ILB was excreted in urine, 9% recovered in the lavage fluid, and 80% recovered in tissue (18% in lung, 30% in liver, 28% in skeleton, and 4% in other tissues). The dog lavaged with saline on day 5 only excreted 6% of the ILB in urine, had 1% recovered in lavage fluid and 93% recovered in tissue (18% in lung, 31% in liver, 39% in skeleton, and 5% in other tissues). The dogs lavaged with DTPA in saline on days 0 and 5 and day 0 only excreted 57% of the ILB in urine, had 10% recovered in the lavage fluid, and 33% recovered in tissue (10% in lung, 12% in liver, 9% in skeleton and 2% in other tissues). The dog lavaged with DTPA in saline on day 5 only excreted 9% of the ILB in urine, had 2% recovered in lavage fluid and 89% recovered in tissues (21% in lung, 36% in liver, 27% in skeleton and 5% in other tissues). These results demonstrate the potential usefulness of pulmonary lavage with DTPA in saline for reducing the lung and tissue retention of inhaled $^{144}CeCl_3$ or similar radioactive aerosols that may be accidentally inhaled. The removal of the radioactive material would reduce the radiation exposure of lung and other tissues, thereby reducing the potential for radiation induced diseases. (auth)

34303 RADIOACTIVE CONTAMINATION IN AIR, FALLOUT, AND MILK IN ITALY AND YUGOSLAVIA. Bauman, A. (Institut za Medicinska Istrazivanja i Medicinu Rada, Zagreb); Cigna, A. A.; Ferraris, M. M.; Giorcelli, F. G. G. Fis. Sanit. Prot. Radiaz.; 12: 312-23(Oct-Dec 1968). (In Italian). (RT/PROT-(69)32).

The average monthly values of the concentrations of ^{89}Sr, ^{90}Sr, ^{137}Cs and ^{131}I in milk consumed in Italy during the period 1961 to 1965 are reported. These values are compared with those referring to air and fallout. The deposition of the radioactive contamination is studied in order to obtain a rough forecast of the concentration of some radionuclides in milk. The Italian data are compared with the Jugoslav ones. (auth)

34304 BRONCHOPULMONARY LAVAGE FOR REMOVAL OF INHALED INSOLUBLE MATERIALS FROM THE LUNG. Pfleger, R. C.; Wilson, A. J.; Cuddihy, R. G.; McClellan, R. O. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.). Dis. Chest; 56: 524-30(Dec 1969).

A bronchopulmonary lavage technique utilizing saline washings is described for removing ^{95}Zr-^{95}Nb labeled ZrO_2 microspheres from the left lungs of beagle dogs. As assessed by external counting at 30 days post-exposure, the lungs of groups of dogs not lavaged, and those lavaged on day 0, day 8, day 16, or days 0, 8, and 16 post-exposure, contained 95, 88, 80, 74 and 72 percent of their initial burden, respectively. At sacrifice, 30 days post-exposure, >98 percent of the total radioactivity found in the animals at that time was in the lungs of both the lavaged and control dogs. (auth)

34305 RADIOECOLOGICAL OBSERVATIONS ON PLANTS OF THE LOWER BULLER GORGE REGION OF NEW ZEALAND AND THEIR SIGNIFICANCE FOR BIOGEOCHEMICAL PROSPECTING. Whitehead, N. E.; Brooks, R. R. (Massey Univ., Palmerston North, New Zealand). J. Appl. Ecol.; 6: 301-10(Aug 1969).

The Buller Gorge uraniferous area of New Zealand was studied radiologically to estimate its U mineral potential. Biogeochemical prospecting (the chemical analysis of the plant cover to obtain evidence of mineralization in the soil and rocks beneath) has been used successfully in various other countries, but an initial orientation survey is required that involves studies of the plant-soil relationships and various other ecological factors such as pH, rainfall, and topography. Bedded U deposits are found there in a Cretaceous formation (Hawks Crag Breccia) that comprises nonmarine sandstones, siltstones, conglomerates, and breccias. The trees Nothofagus fusca and Weinmannia racemosa and the shrubs Coprosma australis and Quintinia acutifolia were found to have an α activity and U content that correlated well with the amounts in the soil. The use of pathfinders for U was investigated and showed that Cu and Zn in the soil indicated the presence of U whereas for the vegetation, only the Zn content of dried wood of Q. acutifolia represented the presence of U mineralization. Uneven accumulation of U and α activity by vegetation confirmed that much of the α count of plants is not due to U but to the daughter products such as Ra, Pb, Th, and Pu. The presence of these nuclides was confirmed by γ-spectrometry. Analysis of successive rings of a 90-yr-old specimen of N. fusca showed great disproportionation of U and α activity. (BBB)

34306 ^{131}I FROM ENVIRONMENTAL SOURCES IN NEVADA BOVINE THYROID GLANDS FROM 1961 THROUGH 1968. Blincoe, Clifton; Bohman, V. R. (Univ. of Nevada, Reno). Environ. Sci. Technol.; 4: 425-9(May 1970).

Bovine thyroid iodine-131 concentrations respond rapidly and markedly to releases of fresh fission products to the biosphere. Between 1961 and 1968, distant, isolated releases of fission products and accidental releases from underground detonations as well as distant and near series of atmospheric nuclear detonations were noted. Since sampling occurred biannually, other increases may have occurred which were not noted. (auth)

34307 DECONTAMINATION OF OILS, OILSEEDS, AND OIL-BEARING FRUITS FROM ^{137}Cs. Seher, A.; Zippel, G. (Bundesanstalt fuer Fettforschung, Munich). Fette-Seifen-Anstrichm.; 71: 948-51(1969). (In German).

It was shown by model experiments that ^{137}Cs is removed partly from raw oils and fats during deacidification and to a considerable extent during bleaching. Totally contaminated oilseeds and oil-bearing fruits were freed from ^{137}Cs by diffusion, for which 10% sodium chloride or potassium chloride solutions were used. Recirculation and continuous removal of cesium ions that have already entered the solution intensify and accelerate the decontami-

nation. The attainable degree of decontamination is dependent on the plant material to be treated. (auth)

34308 INTERCEPTION AND RETENTION OF RADIOACTIVE AEROSOLS BY VEGETATION. Chamberlain, A. C. (Atomic Energy Research Establishment, Harwell, Eng.). Atmos. Environ.; 4: 57-78(Jan 1970).

The efficiency of vegetation as a filter for nuclides deposited on the earth's surface is examined. The proportion of the fallout initially retained in the herbage, p, is assumed to be related to an uptake coefficient μ (m^2kg^{-1}) by the relation $1 - p = \exp - \mu w$, where w is the herbage density in kg m^{-2} dry matter. Experimental values of μ lie in the range $2 \cdot 3$ to $3 \cdot 3$ m^2 kg^{-1}, and there does not seem to be any marked dependence on the physical form of the activity. The rate of loss of activity by weathering from foliage is next considered. The field loss coefficient λ_b was found to be of order $0 \cdot 05$ $days^{-1}$ in field experiments during the growing season, but lower values (corresponding to longer retention periods on the foliage) were observed in winter. Representative values of p and λ_b are then used to calculate the normalized specific activity (N.S.A.) of herbage continuously exposed to fallout. The calculations give N.S.A. values ranging from 27 to 55 m^2 days kg^{-1} depending on the value assumed for λ_b and for the time T_o between successive croppings of the herbage. Finally, surveys of the activity of ^{90}Sr and ^{137}Cs in the U.K. and abroad are used to deduce the N.S.A. of foliage exposed to world-wide fallout from weapon tests. Good agreement with the calculated values is obtained, but there is evidence of enhanced N.S.A. values in poor growing conditions. (auth) (UK)

34309 DECONTAMINATION OF COMPLETELY CONTAMINATED POTATOES. Paulus, K. (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe, Ger.). Z. Lebensm.-Untersuch. Forsch.; 139: 282-7(1969). (In German).

Techniques for removing ^{85}Sr and ^{137}Cs from the surface of potatoes were investigated. Solutions of sodium phosphate, citric acid, and oxalic acid up to 2% concentrations were tested. Various pH values of the solutions and temperatures of 90°C (5 min) and 60°C (15 min) were used. A level of ~70% decontamination of ^{137}Cs was obtained with oxalic acid at 60°C. Circulating the solution increased the removal. Other combinations were less effective. The citric acid solution at 60°C was most effective for removing ^{85}Sr. A 0.4% solution of citric acid and treatment time of 16 hr removed 85% of the radiostrontium. Because of the firmness of potato tissue, long treatment times were required. Temperatures above 70°C did not enhance removal of radiostrontium. It is concluded that by various combinations of treatment, over 99.5% of the radiocesium and 80% of the radiostrontium can be removed from potatoes. (BBB)

34310 CONTAMINATION OF FOOD BY RADIOACTIVE FALLOUT CAUSED BY FISSION AND FUSION WEAPON TESTS IN RED CHINA. Morishige, Toshiko (Kyushu Univ., Fukuoka). Nippon Eiseigaku Zasshi; 23: 219-24(Jun 1969). (In Japanese).

Periodic measurements were made in Fukuoka on radioactive fallout in the Standard Diet proposed by the Department of Welfare in Japan. Measurements were also taken on vegetables, milk, and short-necked clams. The level of radioactivity from the fallout deposited on the vegetables resulting from the 1st, 2nd, and 5th nuclear tests in Red China increased markedly from 10 to 200 fold. The levels were much higher than that for the usual amount of fallout on vegetables. A higher level of radioactivity than normal was maintained for several months at the time of the 5th test. The increase or decrease of radioactivity on seasonal vegetables corresponded with the levels of radioactive fallout deposited on the vegetables. The level of radioactivity on the vegetables increased sharply after the tests. Although radioactivity of the vegetables increased from a lower level the level for pasteurized and raw milk did not fluctuate markedly during the test periods. The degree of radioactivity in short-necked clams with shell removed fluctuated considerably (0.5 to 38.9); however, there was no evidence of increase of radioactivity of the clams due to the tests. The radioactivity in the Standard Diet in Japan increased slightly in 1967 compared to that of earlier years. Large particles of radioactive fallout were noted on spinach just after the fifth nuclear test in China, seen by means of autoradiography. Removal of these particles was not completely successful. (BBB)

34311 ^{90}Sr AND ^{137}Cs LEVELS IN TISSUES OF FIN WHALE (BALAENOPTERA PHYSALUS) AND HARP SEAL (PAGOPHILUS GROENLANDICUS). Samuels, E. R.; Cawthorn, M.; Lauer, B. H.; Baker, B. E. (Dept. of National Health and Welfare, Ottawa). Can. J. Zool.; 48: 267-9(Mar 1970).

^{90}Sr and ^{137}Cs were determined in 11 different tissues of the fin whale and 2 different tissues of the harp seal. Muscle tissue in most instances contained more ^{137}Cs than did the other tissues that were examined. The average concentration of ^{137}Cs in whale muscle was 4.5 pCi/g ash and in adult seal muscle was 2.5 pCi/g ash. The highest concentration (3.5 pCi/g ash) of ^{90}Sr was found in whale blubber. (auth) (Canada)

34312 TRANSFER OF FALLOUT ^{137}Cs FROM FEED TO MEAT OF CATTLE. Johnson, James E.; Tyler, Tipton R.; Ward, Gerald M. (Colorado State Univ., Fort Collins). J. Anim. Sci.; 29: 695-9(1969).

Beef samples were collected from 18 animals during the period of 1964 and 1965 and analyzed for ^{137}Cs by gamma-ray spectrometry. Concentrations of this nuclide averaged 247 pCi/kg and ranged from 88 and 445 pCi/kg of meat. The feed intake of ^{137}Cs prior to slaughter was determined, and a transfer coefficient to meat was calculated pCi/kg meat divided by mean daily intake of ^{137}Cs. The transfer coefficient of ^{137}Cs from feed to meat was about twice as great for a high grain ration as for rations high in roughage or about 3.0% as compared to 1.5%. Samples collected between 1962 and 1966 showed a peak in ^{137}Cs concentration in 1964 that was attributed to a peak in fallout deposition on feed stuffs in 1963. It appears that the type of ration and the fallout level both play an important role in determining the concentration of fallout ^{137}Cs in meat. The use of milk levels of ^{137}Cs to estimate concentrations in meat does not appear to be justified because the ^{137}Cs in meat and milk is derived from two different compartments and only under unusual circumstances are these compartments of ^{137}Cs in equilibrium in cattle. (auth)

34313 ^{90}Sr IN THE AUSTRALIAN ENVIRONMENT DURING 1968. Gibbs, W. J. (Commonwealth Bureau of Meteorology, Carlton, Australia); Matthews, W. K.; Moroney, J. R.; Stevens, D. J.; Titterton, E. W. Aust. J. Sci.; 32: 238-44(Dec 1969).

Tabulations are presented, of an Australia-wide survey of ^{90}Sr in global fallout, carried out since 1957. Emphasis is on major centers of population, but data from other areas, including agricultural districts, are reported. Specimens analyzed for ^{90}Sr content were rainwater, soil, milk, flour, and human bones. In some cases, these were compounded to produce a single representative sample for analysis. The mean annual deposit of ^{90}Sr, obtained with funnel ion-exchange fallout samplers, with rain, and as dry fallout during 1968, was the lowest for any year since monitoring began in 1958. Preliminary data from the French South Pacific Ocean Tests (July–Sept. 1968) are given. With the continued decrease in deposition of ^{90}Sr over Australia, 1968 measurements indicated that for a few months towards the end of the year, fallout from these tests contributed a significant fraction of the total ^{90}Sr deposit. Analysis of food-stuffs surveyed during 1968 showed a continuing downward trend in the ratio $^{90}Sr/Ca$ following the 1963–65 peak. This ratio was commensurate with that for bone tissue. Results to the end of 1968 confirm that fallout over Australia from all nuclear weapons tests to date constitutes no significant hazard to the Australian population. (Australia)

34314 REPORT ON THE MEASUREMENT OF ^{137}Cs CONTENT IN BEEF DURING 1966/67. Krocza, W. Wien. Tieraerztl. Monatsschr.; 55: 786-91(1968). (In German).

In 700 g samples of hashed but unprepared beef, the activity of ^{137}Cs was measured by γ-spectrometric procedures in Ringschalen. The results dating from 1966 and 1967 are given, and they show a decreasing tendency in regard to the contents of ^{137}Cs in cattle. (auth)

34315 DECONTAMINATION OF HEN'S EGGS EXTERNALLY CONTAMINATED WITH RADIOSTRONTIUM AND RADIOCAESIUM, AS AFFECTED BY THE DURATION OF STORAGE AFTER CONTAMINATION. Grunewald, H. Arch. Exp. Veterinaermed.; 23: 793-7(1969). (In German).

The effect of the interval of storage between contamination and decontamination was studied on 270 hen's eggs externally contaminated with ^{90}Sr or ^{137}Cs. Although in the case of ^{90}Sr contamination, a storage period of 100 days did not affect the result of decontamination, even a few days of storage was sufficient to reduce the efficacy of ^{137}Cs decontamination, and the efficacy was reduced still further by longer periods of storage. (auth)

34316 REMOVAL OF SOLUBLE RADIOACTIVE ELEMENTS BY MEANS OF TREATMENT OF WATER WITH FLOCCULATION SUBSTANCES. Weissbuch, H.; Cotrau, A.; Velicescu, P. (Hygiene-Institut, Iasi). Z. Gesam. Hyg. Ihre Grenzgeb.; 15: 761-3(1969). (In German).

The classical procedure of treating surface waters by means of aluminium sulfate enables the isolation of soluble uranium salts from surface waters. It does not, however, influence the soluble content of radio-strontium and of radio-cesium. When the process of uranium decontamination takes place, the decantation period of one hour is sufficient to achieve an effective decontamination. (auth)

Dosimetry and Monitoring

Refer also to abstracts 33792, 33794, 33795, 33800, 33801, 33816, 33944, 33953, 33954, 34255, 34539, 34542, 34543, 34546, 34566, 34638, 34721, 35525, 35751, and 36044.

34317 (LF-41, pp 59-60) EARLY MORTALITY FROM INHALED $^{90}SrCl_2$, $^{91}YCl_3$ AND $^{144}CeCl_3$ AND INTRAVENOUSLY INJECTED $^{137}CsCl$ IN BEAGLE DOGS. McClellan, R. O.; Rosenblatt, L. S.; Bielfelt, S. W.; Boecker, B. B. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.).

Inhaled $^{90}SrCl_2$, $^{91}YCl_3$, and $^{144}CeCl_3$ and intravenously injected $^{137}CsCl$ all produce early mortality related to hematopoietic damage in beagle dogs when sufficiently high levels of activity are administered. Deaths were observed at approximately 30 days (12 to 44 days). $LD_{50/early}$ values have been calculated for each of the radionuclides, where early was considered as deaths prior to 50 days. The values (radionuclide, initial body burden in μCi ± S.E./kg, 14 day body burden in μCi ± S.E./kg) are as follows: ^{90}Sr, 256 ± 45, 85 ± 17; ^{91}Y, 622 ± 75, 166 ± 14; ^{137}Cs, 3060 ± 140, 1880 ± 60; and ^{144}Ce, 366 ± 60, 171 ± 20. Corresponding cumulative radiation doses to skeleton to 30 days were calculated in rads and are as follows: ^{90}Sr—1100 ± 220, ^{91}Y—1200 ± 110, ^{137}Cs—1000 ± 40, and ^{144}Ce—990 ± 120. (auth)

34318 (RT/PROT-(69)20) RADIATION INDUCED CHROMOSOME ABERRATIONS: POSSIBILITY OF USING SOME "BIOLOGICAL DOSIMETRY" IN THE IONIZING RADIATION ON HUMANS. Vulpis, N.; Strambi, E. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 10 Apr 1969. 62p. (In Italian). Dep. CFSTI (U. S. Sales Only).

An important aspect of radiation pathology is the examination of chromosome aberrations after irradiation in vivo and in vitro. During recent years the development within the field of cultivation and preparation techniques made it possible to carry out chromosome studies on human cells. These papers are divided into two groups: chromosome studies after irradiation in vivo and irradiation in vitro. Several reports were based chiefly on studies of peripheral blood from patients given x-ray treatment for ankylosing spondylitis or malignant diseases. Chromosome aberrations appearing after diagnostic roentgen irradiation or radioactive iodine were also described. Other reports were concerned with chromosome investigations of humans who received accidental irradiation in connection with nuclear accidents. Finally chromosome aberrations appear to have been found in humans who are exposed constantly to occupational irradiation. The possibility of employing the dose-effect relationship established for the two-hit aberrations (dicentrics and rings), as the basis of human biological dosimetry is discussed. (H.L.W.)

34319 (UCRL-19420, pp 82-92) DOSIMETRY OF π MESONS USING SILICON DETECTORS AND PLASTIC SCINTILLATORS. Raju, Mudundi R.; Lampo, Edward J.; Curtis, Stanley B.; Richman, Chaim (California Univ., Berkeley. Lawrence Radiation Lab.).

The dosimetry of both π^+ and π^- meson beams, with use of semiconductor detectors and plastic scintillators, is described. Depth-dose distributions, isodose distributions, and integral and differential range curves are presented. By use of a time-of-flight system the dosimetric information for a pure pion beam was obtained. The muon and electron contamination reduce the peak-to-plateau ratio. Pion beams of low energy give better depth-dose distributions. Nearly 50% of the dose at the peak of the depth-dose distribution of a π^- beam is found to be caused by nuclear events. (auth)

34320 (UCRL-19420, pp 93-5) RBE AND OER AT VARIOUS POINTS ON THE MODIFIED DEPTH DOSE DISTRIBUTION OF 910-MeV HELIUM ION BEAM USING CULTURED CELLS (TI). Raju, Mudundi R.; Gnanapurani, Madvanath; Madhvanath, Udipi; Lyman, John T. (California Univ., Berkeley. Lawrence Radiation Lab.).

The relative biological effectiveness (RBE) and oxygen enhancement ratio (OER) at different points on the modified depth-dose distribution of a 910-MeV helium ion beam were measured by using the survival of human kidney cells in culture. The results indicate that the RBE at the broad peak region was slightly higher than the effect at the beam entrance (plateau), and the OER was found to be significantly reduced. (auth)

34321 (UCRL-19420, pp 96-8) RBE AND OER OF π^- MESONS FOR INDUCTION OF HETEROALLELIC REVERSION IN DIPLOID YEAST. Raju, Mudundi R.; Gnanapurani, Madvanath; Madhvanath, Udipi; Stackler, Benjamin; Mortimer, Robert K. (California Univ., Berkeley. Lawrence Radiation Lab.).

Induction of heteroallelic reversion in diploid yeast is one of the most radiosensitive systems known. Arginine reversion in a diploid strain BZ34 of Saccharomyces cerevisiae was used to measure the OER for ^{60}Co γ rays and π^- mesons. The values obtained are 2.4 and 1.8 respectively. The response of this system is found to be the same for ^{60}Co γ rays at dose rates of 40 rads/hr and 40 rads/min. (auth)

34322 (UCRL-50790) CALCULATING EXPOSURES AT LONG DISTANCES FROM NUCLEAR-CRATERING APPLICATIONS. Crawford, Todd V. (California Univ., Livermore. Lawrence Radiation Lab.). 23 Jan 1970. 35p. Dep. CFSTI.

Modifications were made to a large-cloud diffusion computer code to permit the calculation of external and internal doses to humans as a function of time and distance downwind for clouds from nuclear-cratering applications. A sample calculation for the clouds from a row charge of five 170-kt thermonuclear devices is included. (auth)

34323 DOSE-TIME RELATIONS FOR INDUCTION OF LUNG CANCER IN URANIUM MINERS. Blair, H. A. (Univ. of Rochester, N. Y.). pp 203-12 of Radiation-Induced Cancer. Vienna; International Atomic Energy Agency (1969). (UR-49-1065).

From Symposium on Radiation-Induced Cancer, Athens, Greece. See STI/PUB-228; CONF-690404.

Lack of data on the concentration of radon and daughters in the air inhaled by uranium miners has made it difficult in the past to establish radiation dose and time factors for induction of lung cancer. Recent determinations by others of ^{210}Pb in the bones of miners who died of cancer provide, however, a new approach. Because ^{210}Pb, a decay product of radon, accumulates in bone but is also excreted, its concentration, after prolonged exposure, will approach an equilibrium which is a measure of the rate of exposure. It is shown that the ^{210}Pb levels in bone at the end of mining are as closely proportional to existing measured and estimated exposure rates to radon as can be expected. It is reasonable, therefore, to use ^{210}Pb levels in bone as measures of prior exposure rates. When this is done a graph of survival times from beginning of exposures against reciprocal of ^{210}Pb shows that lung cancer in man exhibits the two types, early and late, previously revealed in bone cancer in dogs and skin cancer in rats. When the dose is high, death follows initiation of cancer in about 7 years. When the dose is low, the usual case, there is an additional latency of 16 years so the time from attainment of initiating dose to death is 23 years. The initiating dose for the high dose type is about 65 pCi ^{210}Pb per gram years and for the low dose type about 10 pCi per gram years which, in terms of exposure, is about 400 working level months, WLM, as working level, WL, is currently defined. Of the derived parameters the total low dose development time of 23 years is fairly accurate. The high dose development time of 7 years is less certain. The initiating low dose of 10 pCi per gram years is probably moderately accurate, but its counterpart of 400 WLM less certain. The high initiating dose is poorly determined. Twenty three lung cancer cases were involved in this study. Additional cases along with additional environmental and other measurements should increase the accuracy of the dose-time parameters. (auth)

34324 EXPOSURE TO RADIATION IN ORBITAL FLIGHTS. Swart, Hans. Astron. Raumfahrt; No. 2, 58-61(1969). (In German).

Assessment was made of the magnitude of exposure to radiation during orbital flight, in view of the possible adverse effect on personnel manning space stations and laboratories. Tables of expected radiation dose rates are included. Suggestions are made concerning the proper shielding for personnel exposed to radiation doses of 25 Rem or more. (Aerosp. Med.)

34325 METHOD OF INDIVIDUAL PHOTODOSIMETRY FOR IONIZING RADIATIONS. Baran, Tr.; Baciu, I.; Ionescu, M. (Institutul de Medicina si Farmacie, Iasi). Rev. Med.-Chir. (Iasi); 73: 159-64(Jan-Mar 1969). (In Rumanian).

In order to develop an individual photographic dosimetric method, readily accessible, rapid and sufficiently precise to ensure the protection of personnel working in laboratories with ionizing radiations, the common TFA photodosimetric holders with x-ray sensitive dental films were used. Reading was done in the laboratory by means of a specially adapted microphotometer, standardized by reference to the same type of films exposed to known x-ray doses, obtaining a scale ranging between 0.01 and 0.3 R. (auth)

34326 INVESTIGATIONS ON THE DECONTAMINATION OF CHICKEN EGGS CONTAMINATED ON THE OUTSIDE WITH RADIOACTIVE CESIUM. Grunewald, Horst (Veterinary Examination and Animal Hygiene, Halle/Saale, Ger.). Arch. Exp. Veterinaermed.; 23: 819-23(Jul 1969). (In German).

Decontamination experiments for chicken eggs contaminated externally with ^{137}Cs were conducted. Data were given on the effectiveness of seventeen formulations used with and without sub-

sequent rinsing. The following was the most effective: 2% aqueous citric acid solution by immersion for one hour, followed by rinsing. This treatment removed contamination by ^{90}Sr effectively also. Rinsing with running water did not remove ^{137}Cs contamination from the surface. (JPRS)

34327 OUR EXPERIENCES WITH PERSONAL FILM DOSIMETRIC DETERMINATORS. Boros, Laszlo; Miklos, Katalin (Budapest Orvostudomanyi Egyetem). Orv. Hetil., 109: 2318-6 (Oct. 20, 1968). (In Hungarian).

During 1966 the personnel of the Budapest Medical University exposed to radiation hazard was systematically monitored. The results of the film dosimetric study were statistically evaluated on the basis of the commonly used guidelines; the non-occupational radiation burden was not taken into account. It was found that gynecologists handling Ra and ^{60}Co applicators suffered the largest amount of radiation exposure; the staff of the Isotope Laboratory exhibited the lowest exposure, indicating that they took advantage of the required means of protection. Exposure due to β emitters could not be recorded by film dosimetry but this factor is not believed to have contributed substantially to the whole-body irradiation. (TTT)

34328 ^{210}Po URINALYSIS AS AN INDEX OF RADIUM AND/OR RADON EXPOSURE. Vives, Melva V. (Philippine Atomic Research Center, Quezon City). Philippine Nucl. J.; 2: 170-3 (1969).

Data showed that urinary polonium measurement may be used as an index of exposure to radium and daughters. This method is comparable with whole-body counting. The method is simple and cheap. In addition, this study showed that there is an apparent association between the polonium level in the body and cigarette smoking. (auth)

34329 THE USE AND COMPARATIVE STUDY OF DOSE MEASUREMENT MEDIA IN ANIMAL EXPERIMENTS: VARIOUS MEDIA IN ANIMAL IRRADIATIONS. Niki, I. (Frederic Joliot-Curie National Research Inst. for Radiobiology and Radiohygiene, Budapest). Acta Biochim. Biophys. (Budapest); 4: 201-9(1969).

The x radiation dose at several points of the irradiated volume was measured in a homogeneous animal phantom, frozen animal cadaver, and in vivo in small animals. The results obtained in the various media and under various geometric conditions were compared. It was found that the parameters obtained for the homogeneous phantom, frozen cadaver, and living animal by the same exposure were in a good agreement. This, however, approaches only partially the actual conditions. A considerably better homogeneity may be achieved by multilateral irradiation, the degree of irradiation homogeneity changing as a function of the posture of the animal. (BBB) (TSS)

34330 EXPERIMENTAL DETERMINATION OF THE DISTRIBUTION OF DOSE RATE AROUND PUNCTIFORM RADIOACTIVE PARTICLES. Schmidt-Burbach, G. M. (Gesellschaft fuer Strahlenforschung, Frankfurt-am-Main). Health Phys.; 18: 295-6(Mar 1970).

Sites of high energy deposition (hot spots) may occur in biological tissue by incorporation of radioactive matter, and these cause inhomogeneous radiation exposure in the tissue. A knowledge of the distribution of dose around such sites is of interest in studying the relation between radiation dose and radiation effect in the case of inhomogeneous deposits of radioactivity. In the studies described artificial radioactive particles were homogeneously surrounded by layers of tissue-equivalent absorbing material and the energy absorbed in each layer was determined. The particle size was 5 to 20 μm and the maximum activity was about 5×10^{-9} Ci. The particles were then enveloped in tissue-equivalent synthetic layers and the radiation energy emitted was measured by LiF thermoluminescence. The distribution of dose rate was thus determined. The possibility of comparing the results with theory is limited since the assumption of a punctiform radiation source is impossible in practice. The distribution of dose rate around a fallout particle, based on the measurement of the distribution of energy absorption, is shown. (UK)

34331 TRIALS OF ASSESSING THE DOSE OF IONIZING RADIATION AFTER ADMINISTRATION OF NEOHYDRIN LABELED WITH ^{197}Hg OR ^{203}Hg. Baltrukiewicz, Z. (Osrodek Ochrony Radiologicznej i Radiobiologii, Warsaw). Acta Physiol. Pol.; 21: 107-19(Jan-Feb 1970). (In Polish).

After intravenous injection of Neohydrin labeled with ^{203}Hg, the rate of disappearance of the radioisotope from the kidneys was calculated on the basis of measurements of external activity over the kidneys. Effective and biologic half-periods of excretion of ^{203}Hg from the kidneys were calculated. The doses of ionizing radiation to the kidneys from the mercury isotopes ^{197}Hg and ^{203}Hg were calculated from the different components of radiation emitted during the decay of radioactive ^{197}Hg and ^{203}Hg. The assumptions on which the calculations were based and the results of the measurements are discussed. (auth)

34332 DEVELOPMENT OF PHANTOMS SUITABLE FOR DOSE MEASUREMENT: DOSE MEASUREMENT MEDIA. Niki, I. (Frederic Joliot-Curie National Research Inst. for Radiobiology and Radiohygiene, Budapest). Acta Biochim. Biophys. (Budapest); 4: 195-9(1969).

The design and use of small-animal phantoms for radiation dose measurement are described. Homogeneous phantoms of animals in various postures, paraffin-impregnated animal cadavers, and cadavers fixed by freezing were used. The homogeneous phantoms simulating small animals were produced from 2 types of solid phantom materials (Mix D and M 3). With a deviation of a few per cent, their weights and volumes agreed with those of the living animals. Simplicity and durability are the most useful characteristics of such phantoms. The varying tissues of the mammal are substituted by water or by some water-equivalent substance in homogeneous phantoms. The simulation of tissues that differ in density (bone, lung, fat) represents a special problem. To construct an inhomogeneous phantom, preparations preserved by paraffin embedding were tested. Several animal organs (ox thigh, liver, kidneys, brains, spine, and rabbit spine) were embedded into paraffin. Their permeability to therapeutic x rays decreased by 4 to 11%. As a third dosimetry phantom, killed animals were deep-frozen. With this procedure the change in the volume of tissues was minimal, their composition remained practically unchanged, and the animal was fixed in a given posture. It was found that the frozen animal cadaver is best for dosimetry. It enables the satisfactory reproduction of the measurement sites. The homogeneous animal phantoms give inaccurate shapes and compositions of the living organism. (BBB)

34333 CONTRIBUTION TO ELECTRON DEPTH THERAPY WITH PENDULAR IRRADIATION. III. PRINCIPALS OF A NEW DOSE INTEGRATION PROCEDURE FOR CALCULATING DOSE DISTRIBUTION IN PENDULAR IRRADIATION. Rassow, Juergen (Ruhr Univ., Essen). Strahlentherapie; 139: 117-38 (Feb 1970). (In German).

A modification for the calculation method for dose distribution in pendular irradiation from the time-integration method to a spatial integration with planimetry for every point in the phantoms is presented. A more exact determination for circular phantoms is done for central axis pendular therapy with electron beams. It is possible with an appropriate approximation to calculate very precisely for every pendular angle, for various phantom dimensions and for various FA distances, the dose distribution from only one static field of electrons. Besides the relative dose, this calculation allows also to obtain the absolute dose for one pendular period in every point of the phantom, normalized for a dose rate of 100 rd/min in the maximum for a FAD of 100 cm. With tables and schemes examples of calculations are shown for nine different cases with different pendular angles for 43 MeV electrons and field P (1) $5 \times 12/120$ cm in three different phantoms. This new method can also be applied for other radiations, for other phantom dimensions and even heterogenous phantoms. Because of its simplicity, the method can easily be programmed on relatively small computers. (auth)

34334 COMPARISON OF DOSE DISTRIBUTION IN ULTRA-HARD X-RAYS UP TO 42 MV AND ^{60}Co GAMMA-RAYS. Fehrents, D.; Kuttig, Helmut (Univ., Heidelberg). Strahlentherapie; 139: 143-58(Feb 1970). (In German).

With a computer a comparative study was made of the dose distribution obtained for telecobalt and photon beams. The most frequent indications for treatment were considered for the usual body dimensions, and for different treatment methods. It was observed that better dose distributions were obtained for high energy x-rays than for telecobalt, especially for tumors, located at 8 cm depth or more, irradiated with 42 MeV x-rays. The problem of the optimal energy of radiation beams is considered, taking in account the skin dose, the bone dose and the integral dose. (auth)

34335 DETERMINATION OF QUALITY FACTOR FOR 15 MeV NEUTRONS. Krueger, H.; Graul, E. H. (Philipps Univ., Marburg, Ger.). Strahlentherapie; 139: 179-85(Feb 1970). (In German).

An experimental method was described to obtain the quality factor for 15 MeV neutrons. A LET-spectrometer, a proportional and tissue equivalent counter and a gas-delivering device were built. The measured LET-spectra were multiplied point by point with the LET-dependent QF (L), to obtain the integral dose equivalent. This value was correlated with the integral Rad-dose and from this relation the quality factor QF of 7.3 ± 0.4 was obtained for 15 MeV neutrons. (auth)

34336 SECONDARY RADIATION IN A SIEMENS 18 MeV BETATRON. Kraemer, Martin (Staedtische Krakenhauses Moabit, Berlin). Strahlentherapie; 139: 186-95(Feb 1970). (In German).

The transmitted radiation around the irradiation head of a newer model of the Siemens 18 MeV betatron was measured for the 18 MeV photon beam. The total secondary radiation in the plane of the patient's position was also measured for the 18 MeV photon and electron beams. In both cases it was observed that the highest secondary radiation level for the patient occurs in the plane parallel to the electron orbit, whereas the corresponding dose reaches only about one half of this value in the plane perpendicular to the electron orbit. With electrons the dose of the secondary radiation is generally lower than with photons, depending strongly on the irradiation parameters. (auth)

34337 EVALUATION OF RADIATION AND OTHER MUTAGENIC EXPOSURES BY CYTOGENETIC ANALYSIS: A DIAGNOSTIC SERVICE OF THE RADIATION PROTECTION DIVISION. Quastel, M. R.; Bora, K. C.; Abbatt, J. D. (Dept. of National Health and Welfare, Ottawa). Can. Med. Ass. J.; 102: 369-73 (28 Feb 1970).

Following the initial ionizing events, a number of poorly understood physicochemical changes take place within the cell, leading to alterations in the structure of the interphase chromosomes. These changes are observable by light microscopy when the chromosomes appear at metaphase during mitosis. Aberrations produced are a measure of the radiation received by the individual. Rather complex sampling techniques and cytological preparations are described that are quite time-consuming. Computerization and automation are under consideration for improving the assessment procedure. The technique is useful however, in situations where radiation exposure is suspected and film badges are not ordinarily worn. Fifty-six references are given. (Canada)

34338 ^{125}I THYROID UPTAKE SYSTEM. Mantel, Joseph; Ruskin, R. L.; Corrigan, K. E. (Wayne State Univ., Detroit). Health Phys.; 18: 569-70(May 1970).

The advantages of using ^{125}I over ^{131}I for thyroid uptake studies are discussed. It is stated that the overall dose reduction to the thyroid by using ^{125}I with a dual probe uptake system is about one order of magnitude compared to ^{131}I conventional uptakes. The uptake system, an inexpensive attachment to a renogram system, is described. (UK)

34339 IN VIVO gamma-SPECTROMETRIC INVESTIGATION OF THORIUM BODY BURDENS IN THE EGYPTIAN MONAZITE AREA. Morsy, S. M.; Jahns, E.; Aloush, A. A. (Atomic Energy Establishment, Cairo). Health Phys.; 18: 263-6(Mar 1970).

Thorium body burdens in the Egyptian monazite area were investigated using a whole body counter provided with a 4 in. × 8 in. NaI(Tl) crystal. In the course of analyzing the results it was assumed that ^{232}Th which is initially 100% in equilibrium with its daughters reaches a steady state of 40–50% equilibrium in the body due to the metabolic effects. The measurements were performed for the inhabitants of Rosetta as well as workers of the Egyptian black sand refinery plant. No activity was found in either case. (auth) (UK)

34340 AN EVALUATION OF INTERNAL RADIATION EXPOSURE BASED ON DOSE COMMITMENTS FROM RADIONUCLIDES IN MILK, FOOD, AND AIR. Shleien, Bernard (Northeastern Radiological Health Lab., Winchester, Mass.). Health Phys.; 18: 267-75(Mar 1970).

The public health implications associated with intake of radionuclides from the environment by humans can best be evaluated in terms of internal radiation dose commitments to a population from ingestion and/or inhalation of radionuclides found in milk, food, and air. The significance of radiation exposures may then be assessed in the context of established guidelines and by comparison to doses from natural radioactivity over long periods of time. A preliminary attempt was made to provide a means of evaluation of internal radiation exposure applicable to results obtained from existing surveillance networks. Based on surveillance data obtained at the Northeastern Radiological Health Laboratory the dose commitment (mrem per 50-yr) from ^{90}Sr delivered to bone during the period 1961–1968 is estimated to be 502 mrem for an adult. The dose commitment from ^{239}Pu in air to the respiratory lymph nodes is estimated to be 160 mrem. The maximum dose commitment to the infant thyroid accrued in any 1 yr from ingestion of ^{131}I in milk is 89 mrem. The maximum fraction according to the Federal Radiation Council's Radiation Protection Guide encountered during the study was 17.8% due to to ^{131}I in milk. The greatest dose commitment, that from ^{90}Sr to bone, is estimated to be approximately 10% of the dose from natural radiation during the same period. (auth) (UK)

34341 ANALYSIS OF GAMMA RADIATION ENERGY ABSORPTION PHENOMENON APPLIED TO THE SCINTIGRAPHIC TECHNIQUE OF BODY ORGANS EXAMINATION. Malesa, Jan; Nowosielski, Janusz (Physical Inst. of Oncology, Warsaw). Pol. Przegl. Radiol. Med. Nukl.; 33: 805-11(1969). (In Polish).

The influence of γ-radiation energy absorption upon the range and applicability of scintigraphy in human organ examinations was elaborated mathematically. A simplified model of scintigraphic examination was applied for the analysis. In the physical experiment, the radiation of isotopes ^{99m}Tc, ^{131}I, and ^{60}Co was utilized and the water phantom substituted the human body. For the mentioned isotopes, the characteristic range of body thickness was determined and it corresponded to 0 to 6.7 cm, 0 to 9.2 cm, and 0 to 15.8 cm respectively. In these thickness ranges the radioactivity determinations demonstrated the optimal sensitivity. (auth)

34342 FAST NEUTRON CENTRAL AXIS DEPTH DOSE EQUATION. McGinley, P. H. (Georgia Inst. of Tech., Atlanta). Phys. Med. Biol.; 15: 121-3(Jan 1970).

An investigation was made of the relation between the percent absorbed dose at a given depth and the conditions of irradiation during fast neutron therapy. Calculated and measured values are compared. (UK)

34343 STUDIES ON GAMMA-RAY EXPOSURE IN ENVIRONMENT DUE TO ^{41}Ar CLOUD FROM A NUCLEAR REACTOR. Kadokawa, Masayoshi (Japan Atomic Energy Research Inst., Ibaraki). J. Nucl. Sci. Technol. (Tokyo); 7: 34-40(Jan 1970).

The exposure rates of γ rays from ^{41}Ar clouds issuing from the stack of a nuclear reactor were calculated on the basis of Pasquill's cloud diffusion formula, using exact γ-ray attenuation and build-up formulas. The results agreed well with the experimental values of a ^{41}Ar release test performed in 1961 at the Tokai Research Establishment, Japan Atomic Energy Research Institute. The cumulative dose of γ rays received at a given point from shifting ^{41}Ar cloud for a long period was also calculated by considerations based on the probability concept. The validity of the method was confirmed by comparison between the value estimated with statistics of meteorological data and the cumulative value of observed γ exposure. By this method, the maximum allowable release rate was obtained for the Tokai area. (auth)

34344 ON THE DEPENDENCE OF RADIATION EXPOSURE ON THE EXPERIENCE OF THE EXAMINER AND ON THE CHARACTERISTICS OF THE PATIENT. Schoen, Detlev (Univ., Tuebingen, Ger.). Strahlenschutz Forsch. Prax.; 7: 31-48 (1967). (In German).

As criterion for the radiation burden to a patient under fluoroscopy, the radiation dose times surface area (RA) and the exposure duration (T) are selected. The study comprised 53 radiologists and 2845 patients. Thorax, stomach, and colon examinations are studied with and without image intensifiers. During the first four years of medical practice, both RA and T decline approximately by a factor of 2 each. After four years experience only a minor additional reduction of radiation burden occurs. In the course of a workweek, radiation burden reaches a minimum on Tuesday and a maximum on Friday due to fatigue. Physicians with myopia, corrected or uncorrected, usually require an RA 50% lower than physicians with normal vision. As far as patient factors are concerned, the radiation burden increases with size and weight. This relationship, however, only becomes significant in extreme cases. Up to 50 years, the dose burden grows with age approximately by a factor of five. The relationship between dose burden and sex, general condition, and clinical diagnosis are discussed. (H.B.G.)

34345 SHORT DESCRIPTION OF THE SEQUELAE OF A REACTOR ACCIDENT IN MOL (BELGIUM), DECEMBER 1965. Horn, Werner (CCR-EURATOM, Ispra, Italy). Strahlenschutz Forsch. Prax.; 7: 319-22(1967). (In German).

On December 30, 1965 a reactor accident occurred in Mol, Belgium. Handling of the control rods caused an uncontrolled chain reaction exposing three workers. Two of these indicated only 60 mrem, while the main operator received a 50% lethal dose. The dose distribution varied from 5000 rad at the left foot to much lower doses at the head. The mean γ-dose to the body was calculated as 550 r with a 10% component of fast neutrons. Exposure to epithermal and thermal neutrons was negligible. Neutron activation values are given for ^{24}Na and ^{32}P. The clinical picture showed four phases. An initial phase of 24 hour duration, latent period to the 21st day postexposure, a critical phase between day 21 and day 45 with severe leukopenia and hypothermia, and a recovery phase. Because of edema and severe pain, amputation of the left leg became necessary. Thereafter, recovery proceeded uneventful. (H.B.G.)

34346 RESULTS OF A PROGRAM DIRECTED TOWARD REDUCTION OF DENTAL X-RAY EXPOSURE. Rosenthal,

Robert B.; Malcolm, James C. (Alameda County Health Dept., Oakland, Calif.). Radiol. Health Data Rep.; 11: 109-15(Mar 1970).

X-ray safety surveys in 208 dental offices revealed that almost one million radiographic films were exposed annually. A special study was made of procedural factors affecting roentgen exposure at the cone tip of dental x-ray machines; these were film speed, developing technique, and kilovoltage. Although only 27 percent of the offices were using slow or intermediate speed film, they were found to be responsible for 45% of the total cone-tip exposure. A change to faster film reduced their exposure levels by 54%. Offices accepting recommended changes in developing technique reduced their exposure levels by 43%. The program's effect was an overall exposure reduction of 27%. With properly developed fast film, the median exposure levels ranged from 0.19 R/film at 90 to 100 kVp to 0.62 R/film at 45 to 55 kVp. The accuracy of electric and electronic timers was evaluated in selected offices. (auth)

34347 DIAGNOSTIC DENTAL X RAYS AND THE PATIENT: AN OVERVIEW. Radiol. Health Data Rep.; 11: 1-5(Jan 1970).

In 1964, approximately one quarter of the civilian non-institutional population in the United States was exposed to dental x rays. The average estimated skin exposure was 1,144 mR per film. The absorbed doses were on the order of 25 to 80 mrad to organs in or near the direct beam with a genetically significant dose of <0.01 mrad per year. The status of exposure control programs and standards and compliance is discussed and activities for further reducing exposure are identified. (auth)

34348 SURVEY RESULTS OF THE USE OF X RAYS IN THE HEALING ARTS SPECIALITIES IN NORTH DAKOTA, 1964–1968. Kraeger, James A.; Christianson, Gene A. (North Dakota State Dept. of Health, Bismarck). Radiol. Health Data Rep.; 11: 117-28(Mar 1970).

The x-ray facilities of all healing arts specialties (except dentistry) in North Dakota were surveyed by the State Department of Health to determine the degree of compliance of the x-ray facilities with the recommendations published in NBS Handbook 76. An average of 8,529 patients is radiographed per week in the healing arts specialties in North Dakota, for a total of 443,508 patients radiographed per year. Hospitals and multiple-specialty clinics account for 81% of the radiographs. An average of 881 patients receives a fluoroscopic examination each week for a total of 45,812 examinations per year. Of this fluoroscopic workload, 88% are conducted in hospitals and multiple-specialty clinics. Fifty-eight percent of the diagnostic x-ray machines were found to be deficient upon initial evaluation. The majority of the deficiencies were inadequate collimation and/or inadequate filtration of the useful x-ray beam. Major deficiencies resulting in an unnecessary genetically significant dose were found to exist in facilities that expose 195,676 persons annually. Forty-nine percent of the individuals operating x-ray equipment in North Dakota are not registered with The American Registry of Radiologic Technologists. Of the non-registered technicians, 76% had less than a year of x-ray training and 74% indicated that aspects of x-ray protection were not included in their training. (auth)

34349 EVALUATION OF EMISSIONS FROM RADIUM DIAL WATCHES. Klein, Herbert F.; Robinson, Earl W.; Gragg, Royce L.; Rolofson, James W. (Bureau of Radiological Health, Twinbrook Parkway, Rockville, Md.). Radiol. Health Data Rep.; 11: 7-9(Jan 1970).

Seventeen U.S. Army surplus radium-dial pocket watches were examined for radium content. The absorbed dose rates at the surface of the watches were measured and found to vary from 23.8 to 36.1 mrad/hr per μCi. A simulated radium dial watch was constructed and used to estimate absorbed dose rates to various parts of the human body. (auth)

34350 DOSE RATE MEASUREMENTS IN BLADDER AND RECTUM. INTRACAVITARY RADIATION OF CARCINOMA OF THE UTERINE CERVIX. Joelsson, Ingemar; Baeckstroem, Anders. Acta Radiol., Ther., Phys., Biol.; 8: 343-59(Oct 1969).

The performance characteristics of the Siemens Gammameter were defined through separate testing of linearity, quality, and dose rate gradient dependence, temperature dependence, effect of change in temperature and break in priming, as well as of the influence of radial and longitudinal orientations of the probe. The dose rates in the bladder were observed in a clinical study to be higher in the supine than in the lithotomy position and the dose rates at the anterior wall of the rectum increased with the treatment time. (auth)

34351 PELVIC DOSIMETRY DURING RADIOTHERAPY OF CARCINOMA OF THE CERVIX UTERI. Johansson, J. M.; Lindskoug, B. A. A.; Nystroem, C. E. (Univ. of Goteborg). Acta Radiol., Ther., Phys., Biol.; 8: 360-72(Oct 1969).

Cylindric LiF-teflon rods were used as thermoluminescence dosimeters for measuring doses at thirty points inside the iliac and caval veins bilaterally during the internal and external treatment of carcinoma of the cervix uteri. The results indicate that supplementary external therapy compensates for the inadequate and often asymmetric dose distribution of the internal radium treatment. (auth)

34352 RADIATION BURDEN IN RENAL SCINTIGRAPHY. Wolf, R.; Schmidt, K. J. (Univ., Mainz). Fortschr. Geb. Roentgenstr. Nuklearmed.; 112: 389-98(Mar 1970). (In German).

Radiation dose to kidneys, body, and gonads was calculated on the basis of new measurements carried out during renal scanning using ^{203}Hg-Neohydrin, ^{203}Hg-Salyrgan, ^{197}Hg-Neohydrin and ^{99m}Tc-iron complex. Radiation dose to the kidneys using ^{203}Hg-Neohydrin was very high, and it should not be used for renal brain scans. ^{203}Hg-Salyrgan imposes approximately one third, and ^{197}Hg-Neohydrin about one tenth of the radiation burden produced by ^{203}Hg-Neohydrin. The most satisfactory substance was ^{99m}Tc-iron complex that imposed a radiation burden on the kidneys that was only about 2% of that produced by ^{203}Hg-Neohydrin. (TSS)

34353 TISSUE-AIR RATIOS FOR ROTATIONAL THERAPY WITH 32-MeV X RAYS. Starchman, Dale E.; Chao, Jen-hung (Illinois Inst. of Tech., Chicago, Mercy Hospital and Medical Center, Chicago). Radiology; 96: 127-9(Jul 1970).

X rays from a 32-MeV betatron were used in rotational therapy for deep tumors. Tissue-air ratios for 14 × 14 cm fields at a source-to-dosimeter distance of 104 cm do not vary significantly as a function of field size or source-to-dosimeter distance. (auth)

34354 DOSIMETRY OF FAST NEUTRON BEAMS FROM A SMALL MEDICAL CYCLOTRON. Pinkerton, Arthur; Mamacos, James P.; Laughlin, John S. (Sloan-Kettering Inst. for Cancer Research, New York). Contract AT(30-1)-3510. Radiology; 96: 131-6(Jul 1970).

Depth dose distributions in a water phantom and total tissue dose rates were measured for neutron beams from a 30-inch isochronous cyclotron producing 8 MeV deuterons, 15 MeV protons, or 23.2 MeV helium-3 ions using various targets. The reactions employed were ^{9}Be(^{3}He,n), ^{9}Be(p,n), ^{9}Be(d,n), ^{2}H(p,np), and ^{7}Li(d,n). The influence of target construction on beam characteristics was examined. At various phantom depths, gamma-ray contamination and fast and thermal neutron fluxes were measured. The authors conclude that a small medical cyclotron is a satisfactory source of fast neutrons for radiobiological and dosimetric research and has possible clinical applications. (auth)

Radiation Protection

Refer also to abstracts 34191, 34505, 34719, 35109, 35110, 35288, 35289, and 35526.

34355 (CONF-690335, pp 39-43) DIAGNOSTIC X-RAY PROBLEM IN THE UNITED STATES. McDowell, Richard B.; Cole, William S. (Bureau of Radiological Health, Rockville, Md.).

Radiation hazards to patients and medical personnel during diagnostic radiography are reviewed. Procedures that will reduce the radiation dose and assure the safety of x-ray equipment are discussed. (C.H.)

34356 (ORNL-CD-8) INDEXES TO 708 UNCLASSIFIED DOCUMENTS ON CIVIL DEFENSE. Gallar, Joanne S.; Baldry, Wilma H.; Klein, Ann S. (comps.) (Oak Ridge National Lab., Tenn.). Jun 1970. Contract W-7405-eng-26. 222p. Dep. CFSTI.

Author, bibliographic, corporate author, keyword, and report number indexes are presented for 708 unclassified documents on civil defense. (C.H.)

34357 FUNDAMENTALS OF PROTECTION AGAINST IONISING RADIATIONS FOR PERSONNEL USING GAMMA RADIOGRAPHY FOR MATERIALS TESTING. Michon, G. Bull. Inform. A.T.E.N. (Ass. Tech. Energ. Nucl.); Special No., 1-92(1969). (In French).

This book, which was published with the backing of a number of French public and private bodies and of the Euristop Office of Euratom, outlines the fundamental concepts of radiation protection, with which every worker employed in radiographic inspection of materials should be familiar. Aspects covered include: radiation sources; practical determination of the activity of a source as a function of time; principal properties of gamma radiations;

practical determination of exposure rate at a given point; biological effects of radiations and corresponding safety rules; radiation measurement apparatus and its use; principal types of radiographic apparatus used for materials testing; technical measures for protection against ionizing radiation; and French statutory regulations. An appendix contains: exercises in application; an outline of further basic principles of nuclear physics; and summarized data and nomograms. (Occup. Safety and Health Abstr.)

34358 SAFE DISTANCES FOR DOSE-EVALUATION IN THE CARRIAGE OF GAMMA-EMITTING RADIOACTIVE MATERIALS IN SHIPS. Cagnetti, P. (CNEN, Casaccia, Italy); Susanna, A. G. Fis. Sanit. Prot. Radiaz.; 13: 61-71(Jan-Mar 1969). (RT/PROT-(69)31).

A study was made of the sources from which the method was obtained for calculating safe distances between the packages containing radioactive materials and persons or undeveloped photographic and x-ray films, adopted in the international regulation for the carriage of radioactive materials by ship, with a view to achieve a more accurate determination of such distances. An expression was obtained that supplied safe distances as a function of the transport index, duration of the voyage and the product of the thickness of the cargo by its density. From this expression it was possible to plot a nomogram that can be used to determine graphically the safe distances between the radioactive packages and persons or undeveloped film, whatever the transport index, the duration of the voyage, and the product of the thickness by the density of the interposed cargo. (auth)

34359 RADIATION DOSE TO CRITICAL ORGANS DURING PETROUS TOMOGRAPHY. Chin, Frederic K.; Anderson, William B.; Gilbertson, James D. (Harbor General Hospital, Torrance, Calif.). Contract PH 86-67-272. Radiology; 94: 623-7(Mar 1970).

It was found that during routine petrous bone x radiation tomography a dose of 10 R was delivered to the cornea. Simple lead shields placed over the cornea reduced this dose to about 1.0 R. The shielding did not interfere with film quality and was easily accomplished. Tables give the doses to 20 organs and/or areas in Rando phantoms with and without the lead shield and in 10 critical organs in six patients with the shields in place. (auth)

34360 RADIOLOGIC TRAINING AS FACTOR OF RADIATION EXPOSURE. Heuck, Friedrich (Katharinenhospitals, Stuttgart). Strahlenschutz Forsch. Prax.; 7: 49-60(1967). (In German).

Radiation burden to a patient during diagnostic radiology depends on the training of the physician. Errors in diagnosis can occur in difficult cases even after extensive radiological training. Errors in judgement, however, decline significantly with experience. While the expert determines the correct diagnosis during the first examination, the inadequately trained physician misjudges the findings and frequent repetitions of examinations are required with a correspondent increase in radiation burden. Adequate training under supervision is essential for reducing radiation burdens. (H.B.G.)

34361 THE IMPORTANCE OF X-RAY PHOTOGRAPHIC MEASURES FOR RADIATION PROTECTION. Stieve, Friedrich-Ernst (Univ., Munich). Strahlenschutz Forsch. Prax.; 7: 71-117(1967). (In German).

The higher the required information content, the higher is the radiation dose necessary for producing a useable picture. Obviously, a compromise must be found between sufficient information content and low radiation burden to the patient. These optimal conditions are studied for direct x-ray pictures, pictures from a fluoroscopic screen, single pictures with image intensifier, and tape recorders. From the requirements for high quality pictures, dose burdens to the patient can be assessed. Experimental findings are documented by 30 diagrams and pictures. (H.B.G.)

34362 RADIOPROTECTION IN FRENCH URANIUM MINES. Zegers, J. C. (CEA, Fontenay-aux-Roses, France); Pradel, J.; Billard, F. Bull. Inform. A. T. E. N. (Ass. Tech. Energ. Nucl.); No. 81, 5-15(Jan-Feb 1970). (In French).

The prospecting and working of uranium mines exposes personnel to overall external irradiations, internal irradiations due to the inhalation of dusts and radioactive gases, and body contaminations. A system of supervision by individual index cards and a series of preventive measures were put into use as soon as the French mines began operation. While supervision and research expenses are far from negligible (1.80 fr. per kg uranium) they nevertheless contribute less to the cost of protection than do preventive measures such as increasing the ventilation flow rates and adapting standard prospecting and mine working techniques to the special conditions of uranium mining (direct ventilation cost = 5.50 fr/kg U). The development of radioprotection can only be bound up with a better knowledge of the harmful effects of radon and its daughter products. (France)

34363 OOPHOROPEXY: A MEANS OF PRESERVING OVARIAN FUNCTION FOLLOWING PELVIC MEGAVOLTAGE RADIOTHERAPY FOR HODGKIN'S DISEASE. Ray, Gordon R.; Trueblood, H. Ward; Enright, Lee P.; Kaplan, Henry S.; Nelsen, Thomas S. (Stanford Univ., Calif.). Radiology; 96: 175-80 (Jul 1970).

Oophoropexy, placing both ovaries with their attached pedicles in the midline of the pelvis and marking their positions with metallic clips, was performed in 22 patients undergoing pelvic irradiation for Hodgkin's disease. Ovarian function was preserved in 12 patients and one has conceived. The midline position of the ovaries allows them to be shielded with lead blocks during irradiation without interfering with treatment to the external iliac, obturator, or hypogastric nodes. (auth)

34364 GONADAL EXPOSURE OF BOYS AND YOUNG MEN TREATED WITH INVERTED Y FIELDS: ITS REDUCTION AND GENETIC SIGNIFICANCE. Jackson, Herbert L.; Hass, A. Curtis; Sooby, Donna; Marschke, Charles H. (Univ. of Iowa, Iowa City). Radiology; 96: 181-6(Jul 1970).

Young male patients suffering from malignant lymphomas with involvement near the genitalia present a special problem to the radiotherapist. Lead gonad shields for use with inverted Y fields reduce gonadal exposure to γ radiation by about half. The probability of dominant and recessive genetic damage to these patients is relatively small. The therapist as a counselor must provide sufficient information concerning reproduction after therapy and explore alternatives to parenthood with fearful or hesitant couples. (C.H.)

Safety Procedures

Refer also to abstracts 34182, 34185, 34525, 34716, and 34733.

34365 (CONF-690335) CONFERENCE ON FEDERAL-STATE IMPLEMENTATION OF PUBLIC LAW 90-602, MONTGOMERY, ALABAMA, MARCH 24-28, 1969. (Bureau of Radiological Health, Rockville, Md.). Sep 1969. 163p. (ORO-69-4). CFSTI.

Public Law 90-602 (1968) gives the Department of Health, Education, and Welfare (HEW) the authority and jurisdiction for control of all sources of non-ionizing radiation in Federal installations or installations under Federal jurisdiction. The role of the Environmental Control Administration of HEW in carrying out the provisions of the Law is discussed, including the establishment of standards for all electronic product radiation (EPR) equipment manufactured or used in the U.S.A. and enforcement of compliance in Federal installations with appropriate provisions for mutual State participation. It is pointed out that the role of the Federal government is limited to performance standards for electronic equipment relative to radiation emissions while the States will have the responsibility for regulating the use of electronic equipment to protect the public against the hazards from electronic product radiation (EPR). Current standards for the use of electronic products are reviewed. Separate abstracts were prepared on 11 papers that discuss Federal and State programs for the protection of the public against ionizing radiations. (C.H.)

For abstracts of individual papers see: 34182–34185, 34355, 34366–34370, and 34716.

34366 (CONF-690335, pp 4-8) CHANGING ROLE OF THE BUREAU OF RADIOLOGICAL HEALTH, ITS MISSION, GOALS, OBJECTIVES, AND PRIORITIES. Moore, Raymond T. (Bureau of Radiological Health, Rockville, Md.).

The role of the Bureau of Radiological Health in radiation protection programs in the U.S.A. is discussed. Programs include fallout monitoring, the evaluation of the safety of diagnostic x-ray equipment and radium sources used for therapy, and training programs in radiation protection for personnel. (C.H.)

34367 (CONF-690335, pp 44-53) MAGNITUDE AND SCOPE OF NON-AEC CONTROLLED RADIOISOTOPES IN THE UNITED STATES. Villforth, John C. (Bureau of Radiological Health, Rockville, Md.).

The status of a survey of users of sealed ^{226}Ra γ sources in the U.S.A. is reviewed. Uses of radium sources in industry and medicine are discussed. The hazards of using radium in luminous paints are also discussed. (C.H.)

34368 (CONF-690335, pp 54-6) LASER AND MICROWAVE PROBLEMS. Nelson, D. J. Jr.; Solem, D. L. (Bureau of Radiological Health, San Francisco, Calif.).

Hazards to the health of human populations and personnel from the use of lasers by industry and the use of microwaves by industry and in home appliances are discussed. The additional hazard resulting from the availability of lasers and microwave

generators to the general public for use in home workshops is stressed. (C.H.)

34369 (CONF-690335, pp 72-6) COMPATIBILITY. Parker, Roy A. (Louisiana Board of Nuclear Energy, Baton Rouge. Div. of Radiation Control).

Variations in radiation control programs among the various States and problems of communication between State and Federal agencies implementing radiation control programs are discussed. Problems related to the transfer of trained personnel from state to state and problems related to the shipment of radioactive materials between the States are considered. Recommendations for areas of State and Federal cooperation in radiation control programs are included. (C.H.)

34370 (CONF-690335, pp 77-83) STATE-FEDERAL ROLE IN RADIATION CONTROL. Kinsman, Simon (California Dept. of Public Health, Berkeley. Bureau of Radiological Health).

The role of State and Federal governments in the control of radiation exposure of human populations is delineated. It is pointed out that the Atomic Energy Commission has been delegated the authority to control and regulate radiation hazards from ionizing radiation from source, by-product, and special nuclear materials except those materials regulated by the States pursuant to agreement between individual States and the Atomic Energy Commission. State agencies regulate other sources of ionizing radiation under their jurisdiction. The Federal Department of Health, Education, and Welfare formulates national policy with respect to radiation sources other than source, by-product, and special nuclear materials. Both the Atomic Energy Commission and Department of Health, Education, and Welfare carry out research, provide training programs for radiological health personnel, provide consultation services to the States, and provide assistance to the States in assuming responsibility for control of ionizing radiation. The registration, licensing, inspection, countermeasures, and compliance regulations concerning all radiation sources not controlled by the Atomic Energy Commission are the responsibility of the respective States. If any State does not have the resources to execute its responsibilities, it may request assistance from the Atomic Energy Commission and/or the Department of Health, Education, and Welfare. The provisions of Public Law 90-602 relevant to the control of all sources of non-ionizing radiation in installations under Federal jurisdiction and the role of the States in the development of performance standards for electronic equipment capable of generating electronic product radiation (EPR) are reviewed. (C.H.)

34371 URINARY EXCRETION OF RADIOACTIVE ^{210}Po BY MINERS IN CZECHOSLOVAK URANIUM MINES. Holgye, Z. (Inst. for Work Hygiene, Pribram, Czech.). Cas. Lek. Cesk.; 108: 1450-5(21 Nov 1969). (In Czech).

Forty-four miners who spent an average of 11.1 years in the uranium mines, 15 who spent an average of 2.4 years in the mines, and 22 who spent an average of 4.8 years in the mines were investigated. Of the ^{210}Po found in the urine, 4.9%, 16.8%, and 29.4% came from Rn in the respective groups. Fifty-eight percent, 56%, and 44%, respectively, in the individual groups came from the dust in the mines which contains isotopes ^{210}Pb, ^{210}Bi, and ^{210}Po. (JPRS)

34372 RADIATION EXPOSURE AND RADIATION PROTECTION IN RADIODIAGNOSIS IN DENTISTRY. Sonnabend, Eberhard, Zahnaerztl. Mitt.; 59: 1062-6(1 Nov 1969). (In German).

Radiation exposure of dental patients and personnel is analyzed as to skin and gonadal doses and several principles for minimizing radiation damage are derived. Employment of high-sensitive film reduces doses by 60%. Use of a collimator, not exceeding 6 cm in diameter, improves picture quality and reduces gonadal dose by 50%. In all dental radiography, the body of the patient should be protected by an apron containing at least 0.25 mm lead. Dose to skin and gonads is further reduced by a filter of at least 2 mm aluminum. Dental film should never be positioned by hand because, during four years of routine work the accumulated dose to the hands amounts to 5000 R. Positioning of the x-ray unit as well as wall and door construction are discussed from a standpoint of minimizing exposure of persons in the waiting room. (H.B.G.)

34373 STRAHLENSCHUTZ IN FORSCHUNG UND PRAXIS. BAND 7. (Radiation Protection in Research and Medical Practice. Volume 7). Ladner, Hans-Adolf; Messerschmidt, Otfried (eds.). Freiburg i. B.; Verlag Rombach and Co. GmbH (1967). 343p.

Twenty separate abstracts were prepared. The three papers, not included in this report, were analyzed previously. (H.B.G.)

For abstracts of individual chapters see: 34111–34115, 34344, 34345, 34360, 34361, 34374–34379, 34581, 34688, 34689, 34733, and 34734.

34374 UNFITNESS CRITERIA FOR PROFESSIONAL HANDLING OF IONIZING RADIATION FROM THE PHYSICIANS VIEWPOINT. Arnal, Maria-Luise; Gauwerky, Friedrich (Allgemeine Krankenhaus St. Georg, Hamburg). Strahlenschutz Forsch. Prax.; 7: 231-45(1967). (In German).

Legal and practical aspects for the examination of an individual's suitability to be employed in radiation work are discussed from a historical standpoint. At present, employment in radiation work is declined for persons with chronic diseases of the blood or blood forming organs, chronic recurring diseases of the skin, diseases of the central nervous system, previous radiation injury, persons under 18 years, and for pregnant women including the entire lactation period. However, doubts exist about the strictness with which these regulations should be enforced. Examples are given. Ideally, each person should be judged individually and radiation installations should also be classified as to exposure risks. (H.B.G.)

34375 RADIATION PROTECTION STUDIES IN THE UNIVERSITY AREA. Rausch, Ludwig (Justus-Liebig-Univ., Giessen, Ger.); Grundner, Hans-Georg. Strahlenschutz Forsch. Prax.; 7: 263-85(1967). (In German).

115 persons working in radiological installations of a university were studied. Of these, 39% worked in the medical field, 36% in the natural sciences, and the rest in veterinary medicine, agriculture, and meteorology. In 23 individuals, more than 100 mrem/month were measured. Of these, 18 belonged to the medical faculty and handled radium and radioactive gold. The other five belonged to the natural scientist group handling neutron generators and γ-emitters. Most of the high exposures occurred in beginner technicians and nurses. To improve the situation, better training is more important than frequent medical examinations. Health physics should be centralized for monitoring, medical surveillance, and decontamination in the case of accidents. (H.B.G.)

34376 THE HEALTH SUPERVISION OF RADIATION EXPOSED PERSONS AT THE NUCLEAR RESEARCH CENTER IN KARLSRUHE. Moehrle, Guenther (Gesellschaft fuer Kernforschung mbH, Karlsruhe, Ger.). Strahlenschutz Forsch. Prax.; 7: 287-96(1967). (In German).

From 1961 through 1966, medical examinations were performed on about 2500 new employees of the nuclear research center Karlsruhe and on 8500 for follow-up purposes. Reasons for prohibiting or limiting work with possible radiation exposure are discussed. Various diseases leading to elimination or restriction from the work force are tabulated as to incidents. Routine survey for incorporation of radioisotopes is discussed with respect to whole-body counters and urine analysis. The plutonium survey is analyzed in detail and the method for plutonium determination in urine is described. (H.B.G.)

34377 TASKS AND EXPERIENCES OF THE FACTORY PHYSICIAN IN THE URANIUM PROCESSING INDUSTRY. Oster, Harald (DEGUSSA, Hanau, Ger.). Strahlenschutz Forsch. Prax.; 7: 297-303(1967). (In German).

In the corporation for nuclear chemistry and metallurgy, producing uranium fuel elements for nuclear reactors, medical surveillance of workers was performed. A special method for the counting of thrombocytes was developed and monthly urine analysis for uranium content was done. Thus far, 4000 examinations were performed. Not a single case of external radiation damage, skin contamination, or significant incorporation of uranium was observed. A few accidental mishaps did occur; however, clinical consequences were insignificant. (H.B.G.)

Legal Aspects

Refer also to abstracts 34827 and 34836.

34378 CONSTRUCTIONAL AND ORGANIZATIONAL MEASURES FOR RADIATION PROTECTION IN THE RADIOLOGIC DIAGNOSIS. von Stromberg, Goetz (Siemens Aktiengesellschaft, Erlangen, Ger.). Strahlenschutz Forsch. Prax.; 7: 119-31(1967). (In German).

Layout and structural material are discussed for a department of diagnostic radiology. Permissible doses for patients exposed to radiation and for personnel are internationally standardized and determine the basic layout of a radiology department. Two floor plans and a structural cross section through the building are displayed in diagrams. Shielding properties for various construction materials are tabulated. In addition, special protective measures are discussed for rooms containing unexposed films and devices used for diagnostic nuclear medicine. (H.B.G.)

34379 THE RADIATION PROTECTION SUPERVISION IN NORDRHEIN-WESTFALEN FROM INDUSTRIAL MEDICAL VIEW-

POINT. Rahm, Georg. Strahlenschutz Forsch. Prax.; 7: 247-62(1967). (In German).

For the years 1961 through 1965, radiation installations and radiation health problems are statistically analyzed for the state Nordrhein-Westfalen, West Germany. One third of the installations involve medical and research institutions; the other two thirds are used for industrial purposes. The latter utilization increases rapidly, especially for the control of thickness of material and levels of fluids in containers. The number of persons for which radiation work is limited is tabulated together with legal and medical reasons. Legally, pregnancy, age under 18 years, and exposure to more than 10r were the most important reasons for work restriction. Medically, blood diseases, skin afflictions, and lung diseases accounted for 70% of unsuitability for radiation work. The number of incidents in which overexposure occurred is tabulated. Sixteen incidents occurred in medical installations while eight happened in industrial plants. Strikingly, all of the acute skin injuries occurred in industry, while the remaining overexposure cases happened in medical installations. Accidental incorporation of radioisotopes is tabulated as to incidents and type of radionuclide. (H.B.G.)

34380 X RAYS AND THE DENTAL PROFESSION. Taylor, Lauriston S. (National Council on Radiation Protection and Measurements, Washington, D. C.). J. Amer. Dent. Ass.; 79: 885-8(Oct 1969).

Radioprotective practices in dental radiology are reviewed, with emphasis on the programs of the National Council on Radiation Protection and Measurement (NCRP) in this area. The dental use of x rays in diagnosis constitutes one of the important sources of patient exposure. The number of x-ray machines in use by dentists greatly outnumbers all of those in other clinical fields. Sophisticated studies have shown that properly designed equipment, in the hands of careful dental users, adds no significant irradiation to the genetically significant dose of the population. Even poor exposure technics in dentistry contribute only a minor general exposure in comparison with some medical radiologic applications where avoidance of gonadal exposure is often impossible. However, dental uses do involve exposure of the head, including the eyes. Improperly designed equipment can contribute a relatively large amount of unnecessary exposure to some parts of the body. Such exposure is easily minimized with properly designed equipment. The NCRP established a scientific committee of dentists, radiologic physicists, and others experienced in radiation protection to generate protection recommendations for use by dentists. This study has culminated in NCRP Report No. 35 entitled "Dental X-ray Protection." The recommendations in this report, based on principles of radiation protection for both patient and dentist, are to be used in education and in dental practice. (BBB)

Medicine

Refer also to abstracts 33650 and 34373.

34381 PAPILLARY CARCINOMA OF THE THYROID GLAND. SIZES OF 525 TUMORS FOUND AT AUTOPSY IN HIROSHIMA AND NAGASAKI. Sampson, Richard J.; Key, Charles R.; Buncher, C. Ralph; Oka, Hisao; Iijima, Soichi (Atomic Bomb Casualty Commission, Hiroshima. Atomic Bomb Casualty Commission Nagasaki). Cancer; 25: 1391-3(Jun 1970).

Five hundred twenty-five cases of papillary carcinoma of the thyroid, diagnosed at autopsy in Hiroshima and Nagasaki, Japan, were investigated for sex differences; 274 cases were found in 1,453 females, 251 in 1,614 males. The greatest dimensions of the tumors by sex have log-normal distributions, with mean 0.20 cm for females and 0.13 cm for males. Tumors in females were, as a population, significantly larger than tumors in males ($p < .001$). The data are in agreement with the presence of a growth-promoting factor which is greater in females than in males. Tumors initiated by radiation and those initiated by other causes seem to be equally promoted by this factor. (auth)

34382 CLINICAL CARDIOPULMONARY PHYSIOLOGY. Third Edition, Revised. Gordon, Burgess L.; Carleton, Richard A.; Faber, L. Penfield (eds.). New York; Grune and Stratton, Inc. (1969). 764p. $45.00.

A separate abstract was prepared on one chapter that discusses radioisotope scanning methods for the assessment of regional pulmonary function. (auth)

For an abstract of one chapter see: 34514.

34383 PROGRAMME AND ABSTRACTS OF THE ANNUAL SCIENTIFIC MEETING OF THE AUSTRALIAN SOCIETY FOR MEDICAL RESEARCH, 4th, 5th, AND 6th DECEMBER 1969. Proc. Aust. Soc. Med. Res.; 262-304(Nov 1969).

Abstracts of meeting papers are presented. Research aspects covered include cardiovascular, endocrine, gastroenterology, haematology, immunology, metabolism, neurology and psychiatry, renal and respiratory medicine. Radioimmunoassay and tracer studies are significant in 12 of the abstracts, and more routine tracer analyses are involved in several other abstracts. (Australia)

Protective Substances

Refer also to abstracts 34059, 34086, 34267, 34293, 34545, 34579, 34580, 34587, 34588, 34590–34592, 34677, 34678, 34695, 34709–34711, 34762, 34763, and 34777.

34384 (COO–1391-21) ISOLATION OF A FACTOR PREVENTING X-RAY INDUCED LEUKEMIA. Progress Report, February 1, 1969–December 31, 1969. Hodes, M. E. (Indiana Univ., Indianapolis. Medical Center). Contract AT(11-1)-1391. 25p. Dep. CFSTI.

Results of fractionation and leukemia-prevention studies on the proteins of Cohn fractions III, IV, and IV-4 and of other proteins of various origins are presented. Each of these proteins was tested for its ability to prevent lymphosarcoma (leukemia) in x-irradiated C57B1/6 mice. It is still not possible to pinpoint the RLP (radiation leukemia prevention) activity, although some fractions were active in preventing leukemia. The results of attempts to develop a shorter assay for RLP are presented. In general, this approach is centered on the reversal of certain biochemical and physiological effects of a single dose of x-irradiation. The concentration of enzymes such as alkaline phosphatase, lactate dehydrogenase, DNase II and RNA polymerase rises after x-irradiation. Serum injections reverse the rise. DNA polymerase and alpha-2-macroglobulin (trypsin esterase binding activity) fall. Serum injections reverse this effect also. WBC and thymus weight fall after x-irradiation and rise again after serum injection, but the effect is delayed and not as striking as the enzyme effects. Attempts to correlate these findings with leukemia prevention, and to exploit them as an assay for RLP activity, are continuing. (auth)

34385 CHEMISTRY AND BIOCHEMISTRY OF TEA AND TEA MANUFACTURE. Bokuchava, Mikhail A.; Skobeleva, Nina I. (Inst. of Biochemistry, Moscow). Advan. Food Res.; 17: 215-92(1969).

Subjects discussed include: chemical constituents of tea leaf and manufactured tea; significance of biochemistry; thermal treatment to enhance quality and vitamin P of black tea; and biological and nutritional value of tea. Within the discussion of the first subject, the radioprotective properties of tea polyphenols are discussed briefly. It has been reported that tea catechins almost completely eliminated the ^{90}Sr damaging effect on the human body. They absorbed the radioactive isotope and removed it from the body before it reached bone marrow. Other studies have demonstrated that the radioprotective effects were associated with their antioxidative property. This favorable effect was shown whether taken before or after irradiation. It is concluded that since the tea catechins may have both a preventive and therapeutic function, their consumption could be significant for the prophylaxis of radiation disease. (C.O.)

34386 EFFECT OF RADIOMIMETIC COMPOUNDS ON THE ULTRASTRUCTURE OF TUMOUR CELLS. Lapis, K. (Medical Univ., Budapest). pp 97-105 of Radiation-Induced Cancer. Vienna; International Atomic Energy Agency (1969).

From Symposium on Radiation-Induced Cancer, Athens, Greece. See STI/PUB-228; CONF-690404.

Alterations indicating enhanced nucleocytoplasmic interaction were observed after the use of several agents. The alterations in cytoplasmic organelles appeared to be rather similar. After treatment with 5-FU, so-called spotted nucleoli were observed, and after treatment with R-74 and mitomycin C the characteristic phenomenon of nucleolar segregation was observed. There were striking differences in the time of appearance and persistence of the induced alterations that depended on the nature and dosage of the cytostatics applied. Certain agents were capable of activating lysosomes and autophagic mechanisms in tumor cells that were otherwise free of extensive degenerative alterations. This may be important for explaining the effect of these agents upon tumor cells. Ultrastructural alterations at the level of single-cell organelles are not in general specific for any of the agents used. However, for each agent a predominating pattern of ultrastructural alterations in various cell organelles occurs and this pattern appears to be specific for a particular agent. The pattern changes, however, as a function of time elapsed between the treatment and the sample taking. (auth)

34387 INFLUENCE OF RADIOPROTECTORS ON THE INCIDENCE OF RADIATION-INDUCED CANCERS. Maisin, J. R.

(Centre d'Etude de l'Energie Nucleaire, Mol, Belg.). pp 215-31 of Radiation-Induced Cancer. Vienna; International Atomic Energy Agency (1969).

From Symposium on Radiation-Induced Cancer, Athens, Greece. See STI/PUB-228; CONF-690404.

Mixtures of chemical protective drugs are known to increase markedly the short-time survival of x-irradiated mice. A dose reduction factor of 2.8 was observed for the LD 50/30 days for mice treated with a mixture of 2-β-aminoethylisothiouronium-Br-HBr(AET), mercaptothylamine(MEA), cysteine(cyst.), glutathione(GSH) and 5-hydroxytryptamine(5-HT), before an x-ray exposure. Untreated BALB/c^+ male mice were x-irradiated with doses from 350 R to 700 R. Mice protected with AET alone or with a mixture of AET, MEA, cyst., GSH and 5-HT, were irradiated with doses from 350 R to 2000 R. Long-term survival was determined for all groups of mice. At death, the mice were autopsied and the cause of death determined. The long-term survival after a given X-ray dose was improved significantly by the administration of radioprotectors. After a dose of 700 R, all non-protected irradiated mice had died within 610 days, while at this time about 35% of the protected mice were still alive. Mice pre-treated with protectors and irradiated with 1350 R had about the same long-term survival as non-protected ones irradiated with 700 R. Moreover, the total number of cancers and of leukemia observed in the protected mice (1350 R) was about two times lower than in the non-protected ones (700 R). The incidence of cancers after 700 R in the protected mice was about the same as in the non-protected ones, but the tumors appeared at a much later time and could therefore be observed only as a result of the prolonged survival. The mechanism of action of the radioprotective drugs on cancer induction by x-irradiation is discussed. The influence of radioprotectors on the incidence of chromosomal abnormalities in regenerating liver after injection of CCl_4 was also studied. (auth)

34388 SOME METABOLIC EFFECTS OF SULFHYDRYL RADIOPROTECTIVE AGENTS. Goutier, R. (Centre d'Etude de l'Energie Nucleaire, Mol, Belg.). Rev. Med. Liege; 23: Suppl. No. 1, 135-9(Oct 1968). (In French).

Various actions of some sulfhydryl radiation protection agents were discussed. The most detailed effects discussed were concerned with the inhibition of DNA synthesis and mitosis in animal organs following administration of aminoethylisothiourea (AET) or cysteamine (MEA). These actions were measured by the incorporation of ^{14}C-labeled thymidine into the DNA of spleen and thymus of rats. The degree of radiation protection observed was related to the amount of inhibition of mitotic activity. A mixture of AET, glutathione, and serotonin had a greater protective effect and inhibited DNA synthesis in cells of the intestinal crypts more than AET did alone. The metabolic depression caused by the radiation protection chemical was prolonged or reached its peak after the protective effect had ceased. This suggested that the metabolic effect was not directly related to the mechanism of the protective effect, but was more likely a symptom of biochemical injury. Various theories that have been advanced to explain the mechanism of action of radiation protection chemicals on cellular DNA and mitosis were briefly described and discussed. Combined effects of irradiation with whole-body doses of 500 to 1000 R, partial hepatectomy, and treatment with AET before and after irradiation were described and discussed relative to DNA inhibition, mitotic injury, and labeled thymidine uptake. (BBB)

34389 ON THE EFFECTS OF CEPHARANTHIN TO LEUCOPENIA AND THROMBOCYTOPENIA IN THE RADIOTHERAPY OF UROGENITAL MALIGNANT TUMOR. COMPARISON OF ADMINISTERED DOSAGES. Tanaka, Hiroyoshi (Okayama Univ., Japan). Nishinihon J. Urol.; 31: 602-10(Aug 1969). (In Japanese).

For the purpose of preventing and treatment of leucopenia and thrombocytopenia, Cepharanthin was administered to 29 patients with malignant tumor treated by radiotherapy. Group one comprised 14 patients injected 40 mg of Cepharanthin intravenously in the day of radiotherapy. Group two consisted of nine patients injected 10 mg intravenously every day. Group three consisted of six patients prescribed 6 mg daily. Comparison of the three administrations showed that group one was better than the others. This fact was recognized evidently by all of the eleven patients with testicular tumor. It seems that a relatively large dosage of Cepharanthin, i.e., 40 mg/day, is necessary to prevent side effects of the radiotherapy. (auth) (NSA of Japan)

34390 STUDY OF THE EFFECTS OF OXYGEN AND WATER CONTENT ON THE PRODUCTION OF X-RAY-INDUCED CHROMATID ABERRATIONS IN TRADESCANTIA PALUDOSA POLLEN TUBE CHROMOSOMES. Hassan, Wahid (Quinnipiac Coll., Hamden, Conn.). Sci. Ind. (Karachi); 6: 373-80(Oct 1968).

The influence of moisture and oxygen was studied on the production of chromatid aberrations in the Tradescantia pollen tube chromosomes. Metaphases were obtained from the generative nuclei of the pollen. Pollen grains were cultured on slides coated with Bishop's agar medium and were allowed to germinate for 11 hours at 22°C in a moist chamber. These slides were irradiated with a GF x-ray machine (Model OX-250). Irradiation was effected at 30°C and a dose of 500 at the rate of 50 R/min was used as the standard. A count of various aberrations was made from the metaphase configurations of the second microscope division to determine the effect of varying conditions of moisture and oxygen. The treatment of dry pollen with helium (anoxia) reduced the aberration yield to $\frac{1}{3}$ that of air. No difference in the aberration yield was found in the aberration values of pollen when irradiated in dry condition and the wet pollen irradiated within 5 minutes of dusting over the agar-coated slides. A reduction in aberration was found when the pollen was irradiated after 6 minutes of dusting. This reduction was attributed to the energy liberated by the accelerated biochemical reactions and the change in physiological state due to increased water content at the start of germination. (auth)

34391 CORRELATION BETWEEN THE RADIOPROTECTIVE EFFECT OF SOME SUBSTANCES WITH NEUROTROPIC ACTION AND THE INHIBITION OF RESPIRATORY ENZYMES. Pora, E. A.; Abraham, Al. D.; Uray, Z.; Holan, T. Rev. Roum. Biol., Ser. Zool.; 14: 203-10(1969).

The effect of some neurotropics (aminoethylisothiourea, imipramine, chloropromazine, etc.) on the succinoxidase and cytochromoxidase was studied in rat liver. These substances were found to induce a reversible alteration of the mitochondrial respiration by depressing the enzymatic activity. The biochemical modifications noted partially explain the radioprotective mechanism exerted by the neurotropic substances. (Rom. Sci. Abstr.)

34392 CLINICAL RESULTS OF PROTECTIVE EFFECTS OF S-ADCHNON ON RADIOTHERAPY OF MALIGNANT TUMOR. Shinohara, Shinji; Goto, Arito (Kagoshima Univ., Japan). Iryo; 2: No. 3, 75-7(Mar 1969). (In Japanese).

For the disturbances due to radiotherapy of malignant tumor, intravenous injection of S-Adchnon 250 mg once a day about one hour prior to radiation without the combined administration of the so-called leucocytosis promoting agents, was begun with the first treatment. Changes, chiefly in the blood picture (hemoglobin, RBC, WBC, platelet count and bleeding time), of 20 malignant tumor patients who had received ^{60}Co remote radiation and to whom it was possible to administer a focal dose of 4000 to 8000 R, were observed in order to clinically investigate the protective effects of this drug in radiotherapy. No significant effect on RBC or hemoglobin during the course of radiotherapy was observed, nor on the bleeding time. However, an inhibitory effect of S-Adchnon on the decrease of the platelet count and especially on WBC to some extent (for a decrease of 30 to 50%) was clinically observed. As a result, S-Adchnon was found to be an effective drug, without side effects in clinical use during radiotherapy of malignant tumor. (NSA of Japan)

34393 REACTIVITY AND METABOLIC ACTION OF THIOLS AND DISULFIDES IN RELATION TO THEIR RADIOPROTECTIVE CHARACTERISTICS. Liebecq, C. (Univ., Liege). Rev. Med. Liege; 23: Suppl. No. 1, 129-34(Oct 1968). (In French).

The possible chemical reactions of sulfur compounds such as thiols, disulfides, and dithiocarbamates that have radiation protection properties and their metabolic effects that may be related to their radioprotective characteristics were discussed. Some of the compounds discussed were cysteine, cysteamine (MEA), 3-mercaptopropylamine, 4-mercaptobutylamine, 2-mercaptoethanol, 2-aminoethylisothiourea (AET), 3-aminopropylisothiourea, 4-aminobutylisothiourea, 2-aminobutylisothiourea, 2-mercaptoethylguanidine (MEG), and diethyldithiocarbamate. The possibility that the radioprotective actions of these compounds were mediated by anoxia, actions of essential thiols formation of mixed disulfides, reactions with free radicals, chelation of metals, inhibition of basal metabolism, or inhibition of cellular respiration, oxidative phosphorylation, or glycolysis was reviewed briefly. The general hypothesis that radiation protection chemicals may act as radiomimetic drugs to inhibit synthesis of DNA was discussed. However, from the evidence presented, it was not definitely confirmed that these metabolic actions were clearly the bases for the radioprotective actions of the chemicals discussed. (BBB)

34394 EXPERIENCE IN THE USE OF BLEOMYCIN FOR RADIOTHERAPY PATIENTS. Mitsuhashi, Hideo; Furuse, Shin (Hokkaido Univ., Sapporo). Shinyaku To Rinsho; 18: 1413-19 (Oct 1969). (In Japanese).

The radiosensitizing action of Bleomycin was observed clinically in 12 cases of cephalic and cervical tumors and lung cancer. Patients were irradiated for 13 to 51 days with ^{60}Co γ or x rays and

15 mg of Bleomycin was injected every two days or twice a week during the irradiation. The following results were obtained. The mucosal inflammation of mouth cavity was induced by using Bleomycin along with radiation therapy. At the dosage of 4000 R, it was effective for 10 of the 12 cases. It was also effective for the relapsed cases for which radiation therapy had been performed previously. (NSA of Japan) (TSS)

34395 METHOD OF DETERMINING EFFICIENCY OF RADIOPROTECTORS. Gorizontov, P. D.; Davydova, S. A.; Tsypin, A. B. Patol. Fiziol. Eksp. Ter.; 11: No. 6, 80-2(1967). (In Russian).

Methods for determining the efficiency of radioprotectors on the basis of pressure changes in irradiated tissues due to increased permeability generally require complex electronic equipment. A modified method using simple equipment is proposed. An animal under ether is administered a physiological solution by a thin needle into the lower segment of the stomach. The pressure gradually drops as a result of resorption. The rate at which the pressure is lowered is characteristic of tissue permeability. Position change of the mercury level shows the magnitude of the pressure. To record pressure objectively, a special data unit and recording system are used that is connected to an intracutaneous site. Applying this method, experiments were made on 28 male Wister rats (190 to 220 g) to determine the efficiency of beta-mercaptoethylamine and di(3-aminopropyl)cyanimidodithioformic acid. The curve for decrease of pressure with administration of a physiological solution into the lower segment of the stomach was used as a norm. Then animals were γ irradiated (^{60}Co-unit, 220 R/min) with single 700-R doses. Eight to ten minutes before irradiation, seventeen experimental animals were administered beta-mercaptoethylamine (150 mg/kg dose) and three experimental animals were administered di(3-aminopropyl)cyanimidodithioformic acid (20 mg/kg dose) intravenously. Control animals were administered a physiological solution before irradiation. Five to ten minutes following irradiation, decrease of pressure in the lower segment of the stomach was recorded for a 15-min period. Findings show that permeability of tissues increased by 62% in control animals and by only 36% in experimental animals treated with beta-mercaptoethylamine. Di(3-aminopropyl)cyanimidodithioformic acid proved ineffective as a radioprotector and permeability of tissues in the three experimental animals increased by almost the same percentage as in control animals. The method described can be used to study different pathological states involving the permeability of connective tissue and to evaluate the protective and therapeutic efficiency of preparations acting on the connective tissue system. (JPRS) (TSS)

34396 POSSIBILITIES OF INCREASING THE RADIOSENSITIVITY OF CELLS BY CHEMICAL COMPOUNDS. Pelevina, I. I.; Afanas'ev, G. G. (Inst. of Chemical Physics, Moscow). Usp. Sovrem. Biol.; No. 1, 55-71([1969]). (In Russian).

The mechanisms for increasing the radiosensitivity of bacterial and mammalian cells and the possibilities of sensitizing tumor cells are reviewed. The methods discussed include increasing oxygen tension, lowering the level of cellular protection, change in the molecular structure of DNA, and depression of the repair systems. The capacity for sensitization is limited to the inherent properties of the populations because individual cells as well as organisms are heterogeneous with respect to sensitivity to chemical agents and radiation, as manifested by the differences in their reaction to these factors. The lethal effect of irradiation on cell populations or organisms and the effectiveness of combined exposure to chemical agents and irradiation are confined to the resistant portion of the cell populations or resistant organisms. Consequently, no one substance or method now known can achieve an identical level of sensitization for a given biological system, i.e., several methods have to be combined. For example, in the case of halogen-substituted desoxyuridins, conditions must be created for all the cells to enter the phase of DNA synthesis; cells that do not synthesize DNA might be sensitized by substances that act at the level of cellular protection and anoxic cells can be treated with stable free radicals. (JPRS)

34397 ULTRAVIOLET ERYTHEMA IN THE GUINEA PIG. Le Douarec, J. C.; Sicot, N.; Frater, I. (Laboratoires Servier, Suresnes, France). Rev. Fr. Etud. Clin. Biol., 13: 631-5 (June-July 1968). (In France).

The animal is fitted in an asbestos mantel with three 8 mm holes punched in it. The guinea-pig is easily placed at the base of the funnel, then the distance from the irradiating source is carefully established (18 cm). The exposure is controlled by means of a manual shutter and its proper duration is three minutes. The erythema intensity measured was by means of a photographed scale from 1 up to 3; observation was made hourly for 5 hours. The results are expressed in percent planimetric inhibition taking as reference the response of the day before treatment in the same animals. Using series of 5 guinea-pigs per dose, anti-inflammatory activity of Indomethacin has been studied and a good dose-response curve was obtained. (auth)

34398 BACTERIAL ENDOCARDITIS: EFFECT OF DIMETHYL SULFOXIDE IN X-IRRADIATED AND NONIRRADIATED RATS. Highman, Benjamin (Armed Forces Inst. of Pathology, Washington, D. C.); Altland, Paul D.; Hanks, Alan R.; Rantanen, Norman W. Arch. Pathol.; 88: 645-52(Dec 1969).

Irradiation prior to injection of bacteria increased the susceptibility of rats to bacterial endocarditis. Whether a radioprotective compound, such as dimethyl sulfoxide (DMSO), would increase the resistance of such animals to infection was studied. To aid in evaluating the effect of irradiation and of DMSO, the effect of DMSO was also studied in nonirradiated rats given the same bacteria after being rendered susceptible to endocarditis by exposure to high altitude hypoxia. The bacterial endocarditis and associated renal lesions were induced in rats given two 400-R doses of x rays 4 days apart, followed by one or two intravenous injections of a broth culture of Streptococcus mitis. The same cultures induced a similar infection in nonirradiated rats rendered susceptible by exposure to high altitude hypoxia. DMSO did not affect the lesions in nonirradiated animals but reduced the incidence and severity of lesions in irradiated rats. The lesions in the irradiated, in contrast to those in the nonirradiated, animals presented little or no inflammatory reaction, and the bacterial vegetations contained little or no demonstrable fibrinous material. These histopathologic differences are attributed in part to the reduction in leukocytes and platelets. It is suggested that the effect of DMSO in the irradiated animals was related to its radioprotective properties rather than to any bactericidal or other nonspecific effect. (BBB)

34399 THE EFFECT OF PARENTERAL YEAST TREATMENT (LYOPROPER) ON RADIATION INJURY. Hoffmann, H. Arbeitsmed. - Sozialmed. - Arbeitshyg.; 4: 31-2(Jan 1969). (In German).

Effects of parenteral administration of a yeast cell preparation (Lyoproper) on survival of mice x irradiated with 5 consecutive daily whole-body doses of 750 R were studied. All irradiated animals not treated with Lyoproper died within 2 weeks of irradiation. Out of 30 animals pretreated with yeast cells, 20 were still alive 30 days after irradiation. Leukocyte counts in the untreated animals decreased sharply within 6 hr after irradiation, but they were not altered in treated animals. In 40 humans irradiated after surgery for uterine or mammary carcinomas, treatment with Lyoproper improved their general physical condition, improved their blood picture, and lessened pain. Skin transplants were much more successful in patients treated with Lyoproper than in untreated patients. In 8 of a series of 10 patients irradiated after surgery for mammary or gastric carcinomas and treated with Lyoproper, serum albumin, serum globulin, total proteins, and serum enzyme levels remained at normal levels. Best results were obtained if the Lyoproper was given prior to irradiation. (BBB)

34400 EFFECT OF CYSTEINE ON RADIOINDUCED CHANGES OF GLUTATHIONE CONTENT IN RAT ORGANS. Rathgen, Guenther H. (Univ., Mainz). Strahlentherapie; 139: 243-50 (Feb 1970). (In German).

An intraperitoneal injection of cysteine (140 mg/kg body weight) five minutes before whole-body irradiation of 800 R reduces the increase of glutathione content in the blood that normally occurs after whole-body irradiation alone, from 80% to 11%. 24 hours after irradiation 65% of the control value of glutathione is found; without cysteine the concentration of glutathione is increased with 50% in the liver when compared to normal controls. During the whole observation time an increased level of glutathione is observed in the kidneys and the spleen of irradiated animals, treated with cysteine. This was not observed in the solely irradiated animals. A whole-body irradiation with 800 R provokes already after 30 minutes a marked decrease of blood levels of glutathione, followed by an increase after 120 minutes. After cysteine, high levels were observed during 24 hours. The modifications of GSSG-concentration were not significant in blood and in the organs studied. (auth)

34401 INFLUENCE OF SOME CYTOSTATICS AND OTHER BIOLOGICALLY ACTIVE SUBSTANCES ON CATHEPTIC ACTIVITY IN ORGANS OF NORMAL AND IRRADIATED RATS. Lebez, D.; Turk, V.; Gubensek, F.; Kregar, I. (Jozef Stefan Nuclear Inst., Ljubljana, Yugoslavia). Strahlentherapie; 139: 217-20(Feb 1970).

Proteolytic activity in supernatants of homogenates of different rat organs was measured. A comparison was made between normal and irradiated ones as well as samples obtained from rats treated with menadione, diepoxybutane, Na-gibberelinate and chloramphenicol without and with irradiation of 900 R. It was shown that substances with positive redox potential promote the formation of free cathepsins not only in vitro but also in vivo in most cases. (auth)

34402 VALUE OF HOMO- AND AUTOTRANSPLANTATION OF BONE MARROW PRESERVED BY FREEZING IN ACUTE RADIATION SICKNESS. Rakhmatullaev, A. R. (Rostov-on-Don Medical Inst., USSR. Scientific Research Inst. of Hematology and Blood Transfusion, Tashkent). Med. Zh. Uzb.; No. 7, 43-5(1969). (In Russian).

Homoautografts, and especially autografts, of bone marrow preserved by freezing were found to have a favorable effect on the course of acute radiation sickness in rabbits irradiated with 100 R as judged by the average life span (72.5, 50, and 26 days in the animals receiving autografts, animals receiving homografts, and the control, respectively), survival rate (72.5, 45.4, and 22.2%, respectively), and composition of peripheral blood. (JPRS)

34403 RADIATION SENSITIZERS IN ULTRA-VIOLET IRRADIATION OF CELLULAR SYSTEMS. Ortu-Busello, M. A.; Quintiliani, M.; Sapora, O. (Istitito Superiore di Sanita, Rome). Int. J. Radiat. Biol. 16: 393-6(1969).

It was shown that iodine compounds and NEM increase the uv radiation damage to red-cell membranes as they do for damage by ionizing radiation. Moreover, as with ionizing radiation, iodine compounds lost any activity if washed away before irradiation, whereas NEM retained part of its activity. On the contrary, uv radiation lethality of E. coli B/r did not show any enhancement, either by iodine compounds or by NEM. A protective effect was demonstrated, the order of magnitude of which appeared to be in a fair relation to the absorbancy of tested compounds at 254 nm. (auth) (UK)

34404 CHANGES IN THE ACTIVITY OF ADENOSINEDEAMINASE IN ERYTHROCYTES AND IN THE LIVER AND OF 5'-AMP-DEAMINASE UNDER THE INFLUENCE OF IONIZING RADIATIONS. Haler, Constanta; Busuioc, Aspazia; Ababei, Leonid. Stud. Cercet. Biochim.; 11: 391-8(1968). (In Rumanian).

The activity of adenosine deaminase was studied in erythrocytes and in liver homogenates of normal and irradiated rabbits and in rats. The 5' AMP deaminase in liver homogenates of normal and irradiated animals was also studied. It was found that under the influence of ionizing radiations, the activity of adenosine deaminase in erythrocytes and in liver decreases. The 5' AMP deaminase acitvity also diminished in the irradiated liver. The adenosine deaminase in erythrocytes can be reactivated by reduced glutathione, final concentration 0.01 mM. The deaminase from erythrocytes and from liver, as well as the 5' AMP deaminase, are inhibited by mercuric chloride in a final concentration of 0.01 mM and by copper sulphate in a final concentration of 1 mM, not only in irradiated but also in normal animals. The activity of erythrocytes and liver adenosine deaminase that is inhibited by ionizing radiations could be preserved by cystamine administered in vivo. In vitro a reactivation with Mg^{++}, Ca^{++}, and reduced glutathione may be obtained. (auth)

34405 THE EFFECT OF BONE MARROW HOMOTRANSPLANTS ON THE HEALING OF LIVER WOUNDS COMBINED WITH SEVERE RADIATION TRAUMA. Ogii, P. E.; Chumak, A. S. Vestn. Khir.; No. 8, 37-41(1969). (In Russian).

Six series of experiments were performed on rabbits, namely: group 1 animals received a mechanical liver injury but no irradiation or bone marrow transplants; group 2 animals were not irradiated after injury but received transplants; group 3 animals were subjected to combined mechanical and radiation trauma but did not receive transplants; groups 4, 5, and 6 animals received transplants 24 hours, 72 hours, and 6 days, respectively, after the combined mechanical and radiation trauma. The general condition of the animals in the first group was not seriously affected by the injury and differed little from that of controls; some of the animals died. The second group of animals was little affected by the transplants, but the third group developed severe radiation sickness, with 14 of the 20 rabbits dying 1 to 13 days from the time of irradiation and injury. In groups 4, 5, and 6, bone marrow transplantation 1 to 6 days after the combined mechanical and radiation trauma mitigated the course of radiation sickness and lowered the mortality rate. The best results were obtained when animals received the transplants within 3 days. (JPRS)

34406 ON THE RADIOPROTECTIVE EFFECT OF AET ON THE SMALL INTESTINE EPITHELIUM OF IRRADIATED MICE. II. THE CELL PROTECTOR EFFECT AT DIFFERENT STAGES OF THE MITOTIC CYCLE. Barkan, R. S. (Central Research Inst. of Roentgenology and Radiology, Leningrad). Tsitologiya; 12: 127-9(Jan 1970). (In Russian).

A thymidine-^{3}H incorporation was employed for studies of the protective role of AET on the chromosome aberration rate in the intestinal epithelial cells irradiated at different stages of the mitotic cycle. The number of anaphases with chromosome aberrations in crypt epithelium of mouse small intestine exposed to 700 rad was determined during the first mitotic division. The protector was found to exert its influence mainly on the cells that were in the early S-period at the moment of irradiation. (auth)

34407 ROLE OF SYNTHETIC AND NATURAL ANTIOXIDANTS IN RADIOSENSITIVITY. Burlakova, E. B.; Dzyuba, N. I.; Slepukhina, L. V.; Emanuel, N. M. (Inst. of Chemical Physics, Moscow). Tr. Kaz. Nauch.-Issled. Inst. Onkol. Radiol.; 6: 125-8 (1969). (In Russian).

The radioprotective and radiosensitizing properties of synthetic inhibitors of radical reactions are discussed. The influence of these inhibitors on natural antioxidants resulted in radiosensitivity changes. Effects of synthetic inhibitors were similar when injected before or after radiation. This observation is discussed in relation to the role of antioxidants in the recovery process. (auth)

34408 INFLUENCE OF SOME FLAVONOID GROUP PREPARATIONS UPON THE RADIOSENSITIVITY OF INOCULATED TUMORS. Baisheva, S. A.; Balmukhanov, S. B.; Ayapbergenov, E. K. (Inst. of Oncology and Radiology, Alma-Ata, USSR). Tr. Kaz. Nauch.-Issled. Inst. Onkol. Radiol.; 6: 136-40(1969). (In Russian).

The radiosensitizing action of four flavonoid compounds was investigated. The effect of radiation on M-1 and RS-1 sarcomas was enhanced 13 to 34% by catechol polymers, a mixture of leucodelphinidin polymer with sugar, and a mixture of catechols (gallic ether, gallic acid, pentahydroxyflavon). A combination of flavonoids (quercetin, mirecitin, and their ethers) proved to be ineffective. (auth)

34409 INFLUENCE OF A MIXTURE OF FOUR LEUKOANTHOCYANIDINES ON THE RADIOSENSITIVITY OF INOCULATED SARCOMA M-1. Baisheva, S. A. (Inst. of Oncology and Radiology, Alma-Ata, USSR). Tr. Kaz. Nauch.-Issled. Inst. Onkol. Radiol.; 6: 148-50(1969). (In Russian).

It was established that a mixture of four leucoanthocyanidins (leucopelargonidin, leucocyanidin, leucodelphinidin, and leucodelphinidin-glucoside) had marked radiosensitizing properties. The effects of radiation were enhanced by 33 to 82%. (auth)

34410 INFLUENCE OF LEUKODELPHINIDINE ON THE GROWTH AND RADIOSENSITIVITY OF INOCULATED TUMORS. Ayapbergenov, E. K.; Baisheva, S. A. (Inst. of Oncology and Radiology, Alma-Ata, USSR). Tr. Kaz. Nauch.-Issled. Inst. Onkol. Radiol.; 6: 151-4(1969). (In Russian).

Leucodelphinidin showed different properties depending on its concentration. A concentration of 5 mg/kg had a healing effect on irradiated rats; a concentration of 40 mg/kg had a radiosensitizing effect on transplanted tumors; a concentration of 60 to 100 mg/kg had a marked antitumor effect on three transplanted tumors. (auth)

34411 ROLE OF CHINONS IN THE RADIOMODIFYING ACTION OF FLAVONOIDS AND CHINOIDS. Bokaeva, S. S.; Bagina, M. P.; Berdina, M. A.; Kabiev, O. K. (Inst. of Oncology and Radiology, Alma-Ata, USSR). Tr. Kaz. Nauch.-Issled. Inst. Onkol. Radiol.; 6: 155-8(1969). (In Russian).

An increase in the quinone content of RS-1 tumors following injection of phenol compounds (leucoanthocyanidins and catechols) and quinonoid compounds (vicasol) was shown by the polarographic method. The content of quinones was greater when drug administration was combined with irradiation. The effect was maximal when drugs were given 60 min before irradiation. (auth)

34412 RADIOSENSITIVITY OF THE HAIR FOLLICLE AND INDICES OF OXIDATING AND REDUCING POTENTIAL IN THE USE OF SOME RADIOMODIFYING AGENTS. Koposova, R. P.; Ayapbergenov, E. K.; Narimanova, L. Kh. (Inst. of Oncology and Radiology, Alma-Ata, USSR). Tr. Kaz. Nauch.-Issled. Inst. Onkol. Radiol.; 6: 159-66(1969). (In Russian).

Radiation damage and oxidation-reduction changes were studied in skin of mice following administration of radiosensitizing agents. A decreased radiosensitivity was correlated with the use of these agents. The relation of the magnitudes of the oxidation-reduction potential to the phase of the hair cycle was determined. (auth)

34413 ACTION OF HYDROXYUREA ON THE TUMOR RATE AND THE RADIOSENSITIVITY OF TRANSPLANTABLE SARCOMA M-1. Balmukhanov, S. B.; Baisheva, S. A.; Terazima, T. (Inst. of Oncology and Radiology, Alma-Ata, USSR. Scientific Research Inst. of Radiology, Kyoto). Tr. Kaz. Nauch.-Issled. Inst. Onkol. Radiol.; 6: 174-6(1969). (In Russian).

Hydroxyurea caused a 36% inhibition of growth of M-1 sarcoma following three intraperitoneal injections (50 mg/kg). There was a slight radiosensitizing effect. (auth)

34414 CHANGE OF TUMOR RADIOSENSITIVITY BY MEANS OF HYPOXIC STATES. Balmukhanov, S. B. (Inst. of Oncology and Radiology, Alma-Ata, USSR). Tr. Kaz. Nauch.-Issled. Inst. Onkol. Radiol.; 6: 184-94(1969). (In Russian).

It is pointed out that when high pressure oxygen is inhaled, the oxygen in the tumor does not reach the necessary level for enhancement of radiosensitivity. An increased therapeutic index can be obtained by decreasing the oxygen tension in normal tissues. The methods used for decreasing the oxygen tension in normal tissues do not produce a decrease in the oxygen tension of the tumors. Results of treatment of osteosarcomas using a 12,000 R dose administered in 3,000 R fractions were very successful. Effects of hypothermia on the entire organism and on the tumor and its surrounding tissues are discussed. The immediate results of treatment of patients under conditions of total and local hypoxia are presented. (auth)

34415 IRRADIATION OF TRANSPLANTED TUMOR DURING pO_2 CHANGES IN TISSUES INDUCED BY NORADRENALINE. Bernshtein, V. A. (Inst. of Oncology and Radiology, Alma-Ata, USSR). Tr. Kaz. Nauch.-Issled. Inst. Onkol. Radiol.; 6: 206-9 (1969). (In Russian).

Following noradrenaline injection into rats a temporary decrease of oxygen tension occurred in subcutaneous tissues, muscle, and RS-1 subcutaneous tumor transplants. Inhibitory effects of radiation on tumors were less marked under these conditions. Radiation damage to the skin was also less marked. (auth)

34416 INFLUENCE OF MEXAMINE ON pO_2 IN NORMAL AND TUMOR TISSUES. Rampan, Yu. I.; Berezhnova, L. I.; Osipov, N. E. (Inst. of Experimental and Clinical Oncology, Moscow). Tr. Kaz. Nauch.-Issled. Inst. Onkol. Radiol.; 6: 210-14(1969). (In Russian).

Oxygen tension was decreased less in sarcoma 45 than in skin, bone marrow, and intestine of 30 rats by intraperitoneal injection of mexamine. In 12 dogs intramuscular injection of mexamine decreased oxygen tension more in mammary gland and skin tumors than in bone marrow and skin. The significance of the data for radiotherapy is discussed. (auth)

34417 CONTENTS OF SULFHYDRYL GROUPS IN RS-1 TUMOR IN IRRADIATION DURING TOURNIQUET ANOXIA. Mironenko, N. I.; Gordienko, G. P.; Balmukhanov, S. B. (Inst. of Oncology and Radiology, Alma-Ata, USSR). Tr. Kaz. Nauch.-Issled. Inst. Onkol. Radiol.; 6: 244-7(1969). (In Russian).

Effects of a 2000 R dose of radiation on the sulfhydryl content of RS-1 tumors were observed under conditions of hypoxia obtained by the use of a tourniquet. Effects of radiation alone and hypoxia alone were also studied. There was no change in the sulfhydryl content following radiation alone, while an increase was observed following hypoxia alone. Radioprotective effects of hypoxia on the content of sulfhydryl groups and soluble proteins were observed. (auth)

34418 IMMEDIATE RESULTS OF TREATMENT OF BONE SARCOMAS OF LIMBS UNDER CONDITIONS OF LOCAL HYPOXIA. Balmukhanov, S. B.; Poxdnukhov, L. G.; Kusainov, A. K.; Kossev, A. K.; Khusnutdinova, G. I.; Kazieva, Kh. A.; Kauashev, S. K.; Kelimbetova, F. K. (Inst. of Oncology and Radiology, Alma-Ata, USSR). Tr. Kaz. Nauch.-Issled. Inst. Onkol. Radiol.; 6: 252-5 (1969). (In Russian).

Radiotherapy was administered to 30 patients with osteosarcomas under conditions of hypoxia obtained by the use of a tourniquet. A total dose of 9000 to 12,000 R was given in four fractions at weekly intervals. Immediate and early results of the treatment were satisfactory. (auth)

34419 APPLICATION EXPERIENCE OF CET-1 IN CASE OF THE RADIOTHERAPY OF MALIGNANT TUMORS. Nobechi, Tokuro; Terada, Hideo (St. Luke's International Hospital, Tokyo). Shinyaku To Rinsho; 18: 1075-82(Aug 1969). (In Japanese).

Using the internally used granule of Cytochrome C, CET-1, for the patients treated by the radiotherapy, the authors investigated the observations of their peripheral blood and marrow. The experimental cases were 20 cases of malignant tumor, which had never received the radiotherapy, 7 cases of cancer of the breast, 3 of cancer of the urinary bladder, 2 each of lung cancer, uterine cancer and laryngeal cancer, and 1 each of seminoma, Hodgkin's disease, malignant thymoma, ovarian cancer—and all these cases were irradiated by ^{60}Co. Except 2 cases each of lung cancer and laryngeal cancer, and 1 case each of uterine cancer and malignant thymoma, the others were irradiated after operation. The duration of irradiation was 4 to 8 weeks and CET-1 was administered by 30mg/day every day. For all cases, the blood test (the number of leucocyte and erythrocyte, hemoglobin, hematocrit, and blood platelets) and the liver function test (CCF, Kunkel's test, GOT, alkali phosphatase, serum protein fraction and whole protein) were performed. As for the results of using CET-1 with a large quantity of irradiation for long period, it was found that CET-1 is effective for the prevention of the inhibition of hematopoiesis due to radiation lesion; and in the change of myelogram, the decrease of hematopoiesis was not observed. Accordingly the radiotherapy could be continued in almost all cases until the completion of the scheduled radiation dose. No side effect due to CET-1 was observed. (NSA of Japan)

Radiation Sickness and Injuries

Refer also to abstracts 34139, 34302, 34676, and 34693.

34420 RECTOSIGMOID LESIONS SECONDARY TO HIGH-ENERGY RADIATION THERAPY. Garbagna, P.; Paolini, F. A.; Nicolato, A. (Univ., Pavia, Italy). Minerva Radiol.; 14: 381-7(Sep 1969). (In Italian).

Rectal and sigmoid lesions observed in a group of patients subjected to high-energy radiation therapy (42-MeV betatron) for malignant neoplasia of the bladder and uterus at the Pavia University Radiology Department are described. A brief account of the literature data is followed by a study of the frequency of rectosigmoiditis, its clinical and radiological appearance, and the therapeutic means employed in its treatment. (auth)

34421 TRANSPLANTATION OF FOETAL HAEMOPOIETIC CELLS IN IRRADIATED RHESUS MONKEYS. Van Putten, L. M.; Van Bekkum, D. W.; De Vries, M. J. (Organization for Health Research TNO, Rijswijk, Netherlands). pp 41-9 of Radiation and the Control of Immune Response. Vienna; International Atomic Energy Agency (1968).

From Panel on Radiation and the Control of Immune Response, Paris, France. See STI/PUB-175; CONF-670669.

For the treatment of x-irradiated Rhesus monkeys, studies were made of the effect of fetal liver-cell suspensions. It was found that hemopoietic repopulation could not be obtained by injection of a suspension from only one fetal liver. With pooled fetal liver-cell suspensions containing 4 to 11×10^8 hemopoietic cells per kilogram body weight of the recipient, one out of five monkeys showed repopulation after 800 R and three out of five after 900 R. It is concluded that calculations on the basis of the number of hemopoietic cells that fetal liver is less effective than adult bone marrow. The fact that adult bone-marrow grafts taken under the same conditions is tentatively attributed to the capacity of bone-marrow to suppress the residual immunological activity of the homologous host, a capacity which is less developed in fetal cells. As far as practical aspects are concerned, it is concluded that the dependable application of human fetal livers as a source of hemopoietic cells for transplantation is technically not feasible. (auth)

34422 NERVE SUTURE IN A PURULENT WOUND ON A BACKGROUND OF ACUTE RADIATION SICKNESS. Dorogii, A. N. Vrach. Delo, 4: 87-91(Apr. 1967). (In Russian).

The right gluteal nerve was subjected to neurotomy under aseptic conditions at the level of the middle third of the femur on rabbits who were also given a single, whole-body x-ray dose of 600 R. The wounds were flushed for two days with suspensions containing 250 million microbes per 1 kg body weight. After infection the wounds were treated with antibiotics, thiamin, nicotinic acid and ultraviolet irradiation. A total of 116 rabbits was used in the experiments. The animals were killed by introducing air into the ear vein on 3, 10, 15, 30, 60, and 180 days after irradiation. The spinal cord and gluteal nerve were subjected to histological study. The treated animals showed fewer complications due to infection, and fewer vegetative and trophic disturbances. The therapeutic treatment gave rise to joining of the nerve sections with the formation of connective scar tissue that did not hinder the growth of young nerve fibers. Purulent filtrates were not observed. The untreated animals showed signs of much slower recovery with significant slowdown in removal of decay products. The therapy with antibiotics and ultraviolet light prevented the development of wound infection, and created conditions for the complete restoration of the structure and function of the cut nerve. (TTT)

34423 THE EFFECT OF DEXTRAN (MACRODEX) AND GELATIN (PHYSIOGEL) ON HEMORRHAGIC DIATHESIS DURING POSTIRRADIATION THROMBOCYTOPENIA IN DOGS. Kummer, H.; Lundsgaard-Hansen, P. (Univ., Bern). Bibl. Haematol.; No. 33, 472-80(1969).

Fifteen dogs were irradiated at 250 to 385 R with a cobalt-60 γ source. At the 7th to 9th day following whole-body irradiation, the degree of hemorrhagic diathesis was determined by the number of erythrocytes in the lymph of the thoracic duct. Blood was withdrawn from the thoracic duct and rapid volume substitution with 15 ml/kg Macrodex or Physiogel was done at once. The pro-

nounced pressure drop that followed bleeding was completely reversed in a few minutes following replacement. Hematocrit and thrombocyte values were affected by bleeding and volume replacement, with that for the hematocrit being more pronounced. After Macrodex infusion, the increase in hemorrhagic diathesis set in after a latency period of two to three hours and continued to the end of the experiment. This was due almost exclusively to a raised erythrocyte concentration and not to an enhanced lymphatic flow. With Physiogel, a rise in erythrocytes was either not demonstrable or very small generally. It was shown that after irradiation, the lymph of the thoracic duct became increasingly hemorrhagic only when the thrombocytes in the circulating blood dropped below 10,000 cells/mm^3. The thrombocyte counts of animals with a marked increase of erythrocytes in the lymph following dextran infusion usually remained between 10,000 and 25,000 cells/mm^3 right to the end of the experiment. Therefore, it was difficult to explain the enhanced hemorrhagic tendency solely by the degree of thrombocytopenia. It was felt that Macrodex was responsible for the increased hemorrhagic diathesis in four out of six thrombocytopenic dogs. Gelatin did not exert an unfavorable effect on the erythrocyte output into the lymph of the thoracic duct. (C.O.)

34424 PERICARDIECTOMY FOR RADIATION-INDUCED PERICARDITIS WITH EFFUSION. Morton, Donald L.; Kagan, A. Robert; Roberts, William C.; O'Brien, Kevin P.; Holmes, Elbert C.; Adkins, Paul C. Ann. Thorac. Surg.; 8: 195-208 (Sep. 1969).

Although large doses of radiation to the anterior mediastinum may occasionally injure myocardial fibers and cause patchy myocardial fibrosis, the major morbidity and mortality from this irradiation usually results from pericardial injury. Radiation damage to the pericardium initially results in a serofibrinous effusion and pericardial thickening which frequently progresses to tamponade and constrictive pericarditis. Conservative therapy with pericardicentesis frequently results in reaccumulation of the effusion and reappearance of cardiac tamponade. Removal of the radiation-damaged pericardium by subtotal pericardiectomy effectively relieves the cardiac tamponade and probably will prevent the subsequent development of constrictive pericarditis. Subtotal pericardiectomy can be accomplished easily and safely when an effusion is present. Eleven patients with radiation-induced pericardial effusions treated by subtotal pericardiectomy are living and well without evidence of cardiac dysfunction up to 2 years after operation. (auth)

34425 USE OF DRUGS FOR THE PREVENTION OF EARLY PARTIAL SYMPTOMS OF EXPERIMENTAL RADIATION SICKNESS. Santha, Andras (Hungarian People's Army Health Service, Budapest. National Frederic Joliot-Curie Research Inst. of Radiobiology and Radiation Hygiene, Budapest). Honvedorvos; 21: 188-98(Apr-Jun 1969). (In Hungarian).

The antiemetic compounds suited for the prevention of the emetic syndrome, one of the earliest partial symptoms of radiation sickness, were tested on dogs, pigeons, and frogs. This was followed by a study of the effect of the same compounds on other partial symptoms, adynamia and the lowering of physical productivity in mice and rats. Some earlier findings on the favorable antiemetic effect of the domestically produced antiemetic phenothiazine derivatives (Pipolphen, Frenolon) were confirmed. It was found, however, that the tranquilizer effect of the phenothiazine derivatives and of the benzodiazepines has an unfavorable effect on post-irradiational adynamia and lowered physical activity. Therefore, these compounds are not suitable in every respect for the prevention of the early symptoms. Metoclopramide proved to have the most favorable effect; in addition to being the most reliable antiemetic compound, it has no unfavorable effect either on spontaneous or involuntary movement and thereby meets the requirements of a drug without side effects. To some degree it is even capable of setting off the productivity-lowering effect of radiation. Its use in clinical practice is definitely indicated. (JPRS)

Radiodiagnosis

Refer also to abstracts 33896–33901, 33906, 33908, 33913, 33970, 33989, 33997–33999, 34065, 34066, 34341, 34344, 34346–34348, 34352, 34355, 34359–34361, 34380, 34735, 34745, and 34746.

34426 (ACRH-33) SEMIANNUAL REPORT TO THE ATOMIC ENRGY COMMISSION. Gottschalk, Alexander (ed.) (Argonne Cancer Research Hospital, Chicago, Ill.). Mar 1970. Contract AT(11-1)-69. 153p. Dep. CFSTI.

Eight papers within the scope of NSA were abstracted previously. A list is included of 41 publications during the period covered by this report. (C.H.)

34427 (UCRL-19420, pp 9-18) MARKEDLY INCREASED BONE BLOOD FLOW IN MYELOFIBROSIS. Van Dyke, Donald C.; Anger, Hal O.; Parker, Howard G.; McRae, James; Dobson, Ernest L.; Yano, Yukio; Naets, Jean-Pierre; Linfoot, John A. (California Univ., Berkeley. Lawrence Radiation Lab.).

The rate of appearance of an intravenously administered dose of ^{18}F in the skeleton is a function of the size of the skeletal blood supply. Scintigraphic and kinetic data showed a marked increase in skeletal blood flow in patients with myelofibrosis, both idiopathic and secondary to polycythemia vera. There was a clear-cut increase in the minimum bone blood flow from a mean value of 3.3% of cardiac output in the control group to 7.8% in patients with myelofibrosis. That the skeleton shows striking morphologic abnormalities in advanced cases of myelofibrosis is well known, but that the pathology is associated with an increase in bone blood perfusion comparable to that seen in generalized Paget's disease of bone has not previously been suspected. The fact that three of the patients with myelofibrosis and markedly increased bone blood flow were not anemic (two with compensatory myeloid metaplasia and one in the active stage of polycythemia vera) rules out the possibility that the abnormality is secondary to anemia, per se. The hypervascularity is then either primary or secondary to the poorly understood medullary disease. (auth)

34428 (UCRL-19786) LUNG SCANNING WITH ^{99m}Tc FERRIC HYDROXIDE MACROAGGREGATES. Yano, Y.; Anger, H. O.; (cRae, J.; Honbo, D. (California Univ., Berkeley. Lawrence Radiation Lab.). Apr 1970. Contract W-7405-eng-48. 8p. (CONF-700517-3). Dep. CFSTI.

From Preparation and Control of Radiopharmaceuticals Conference, Vienna, Austria.

For scanning, technetium-99m has the useful physical characteristics of high photon yield, short half life, and an easily collimated 140-keV γ ray emission. To utilize these advantages of ^{99m}Tc for pulmonary perfusion studies, a relatively simple and rapid procedure was developed for preparation of ^{99m}Tc-labeled ferric hydroxide macroaggregates in the particle size range of 15 to 40 μ. (auth)

34429 CINERADIOGRAPHIC STUDY OF THE STOMACH, DUODENUM, AND BILIARY TRACT. Grafe, William R. (New York Hospital, N. Y.). CRC Crit. Rev. Radiol. Sci., 1: 5-24 (Jan 1970).

Cineradiographic techniques represent a great advance in radiology, providing a supplemental method of increasing the diagnostic accuracy in examination of the upper gastrointestinal tract and the biliary system. Cineradiography is of particular value when motion and mobility of the organ system are important in recognizing disordered function and disease. It also is applied to teaching and investigation. (auth)

34430 ANGIOCARDIOGRAPHIC DIAGNOSIS OF PERICARDIAL DISEASE. Steinberg, Israel (New York Hospital, N. Y.). CRC Crit. Rev. Radiol. Sci.; 1: 85-162(Jan 1970).

Because disease of the pericardium is of the same density as the heart on conventional roentgenography, cardiac enlargement or dilatation cannot always be distinguished from it. Angiocardiography, because of the opacification of all the cardiac chambers, both right and left sides, readily permits diagnosis of heart enlargement or dilatation. Pericardial effusion is diagnosed when there is more than the usual soft tissue density about the cardiac silhouette (3 mm beyond the opacified right atrium and 10 to 15 mm to the left of the opacified left ventricle); upward and retrosternal displacements of the heart by pericardial fluid are additional characteristic signs. Rotation of the cardiovascular structures within the confines of the pericardium, after angiocardiography, is also a valuable lead for diagnosis of an intrapericardial tumor. Isolated asymmetric right or left-sided cardiac masses adjacent to the opacified heart are usually caused by mediastinal tumors. Angiocardiography is a more superior method for diagnosis of pericardial disease than ultra sound, isotope scanning, or injection of the right atrium with CO_2 because it provides essential information about the state of the cardiovascular system. (auth)

34431 RADIONUCLIDES IN THE DIAGNOSIS OF DISEASES OF THE KIDNEYS AND THE URINARY TRACT. REPORT PRESENTED AT THE CONGRESS. Timmermans, L.; Merchie, G. (Univ., Liege). Excerpta Med. Int. Congr. Ser.; No. 178, 1-156 (1969).

From 1st International Symposium on Radioisotopes in the Diagnosis of Diseases of the Kidneys and the Urinary Tract, Liege, Belgium. See CONF-670667.

The presentation is divided into two parts: Methodology and Applications of radionuclides in explorations of the kidneys and the urinary tract. The first part includes discussion of the physical, technical and methodological bases for use of radioisotopes;

radionuclides uses; renograms; visualizing a radioactive area; and radioisotope methods for the measurement of glomerular filtration rate and renal blood flow. The second part includes: kidney diseases; the transplanted kidney; diseases of the bladder; diseases of the prostate; and radiation hazards. A very extensive list of references is provided. (C.O.)

34432 NEW METHODS OF FUNCTIONAL EXAMINATION OF THE KIDNEYS BY RADIOISOTOPES. Excerpta Med. Ind. Congr. Ser.; No. 178, 159-208(1969).

From 1st International Symposium on Radioisotopes in the Diagnosis of Diseases of the Kidneys and the Urinary Tract, Liege, Belgium. See CONF-670667.

The 12 papers are presented in four sections: New methods of measuring glomerular filtration (6 papers); New methods of measuring renal blood flow (2 papers); Other methods of functional examination of the kidneys (3 papers); and Study of the permeability to electrolytes of the various parts of the human nephron (1 paper). (C.O.)

34433 RADIOISOTOPE STUDY OF RENAL HYPERTENSION. Excerpta Med. Int. Congr. Ser.; No. 178, 209-48(1969).

From 1st International Symposium on Radioisotopes in the Diagnosis of Diseases of the Kidneys and the Urinary Tract, Liege, Belgium. See CONF-670667.

The seven papers of this section are concerned with the radioisotope renogram and its use in cases of renal hypertension. (C.O.)

34434 RADIOISOTOPE EXAMINATION OF THE PROSTATE GLAND AND THE BLADDER. Excerpta Med. Int. Congr. Ser.; No. 178, 279-316(1969).

From 1st International Symposium on Radioisotopes in the Diagnosis of Diseases of the Kidneys and the Urinary Tract, Liege, Belgium. See CONF-670667.

Four papers concerning radioisotopes and the prostate gland and two papers concerning radioisotopes and the bladder are presented. Studies on the prostate gland include radioactive zinc scan studies in dog, man, and monkey; an abstract on radiophosphorus scanning for early cancer detection; palliative treatment of cancer with ^{32}P; and the role of prostatectomy in treatment of prostate carcinomas. Studies on the bladder concerned ^{82}Br and ^{24}Na diffusion through the bladder wall in cancer cases and renal function in intestinal ureterostomy with the aid of the isotopic nephrogram. (C.O.)

34435 RADIOISOTOPE STUDY OF OBSTRUCTIVE LESIONS OF THE URINARY TRACT. Excerpta Med. Int. Congr. Ser.; No. 178, 317-52(1969).

From 1st International Symposium on Radioisotopes in the Diagnosis of Diseases of the Kidneys and the Urinary Tract, Liege, Belgium. See CONF-670667.

Five papers and two abstracts are presented concerning the radioisotopic examination of obstructions of the urinary tract. Studies concern the non-functioning or silent kidney, pregnancy, experimental hydronephrosis, and assessment and management of calculi in the renal pelvis and ureter. Abstracts concern renogram changes in experimental ureter ligation in rats and experience with renograms in urographically silent kidneys. (C.O.)

34436 RADIOISOTOPES IN THE DIAGNOSIS OF VESICO-URETERO-RENAL REFLUX AND OF PYELONEPHRITIS. RADIOISOTOPE EXAMINATIONS IN PAEDIATRIC UROLOGY. Excerpta Med. Int. Congr. Ser.; No. 178, 353-92(1969).

From 1st International Symposium on Radioisotopes in the Diagnosis of Diseases of the Kidneys and the Urinary Tract, Liege, Belgium. See CONF-670667.

Eight papers and one abstract are included. These are presented in three sections: Vesico-ureteral reflux studies (3 papers); Pyelonephritis studies (4 papers); and Radioisotope studies in children (1 paper and 1 abstract). (C.O.)

34437 RADIOISOTOPE STUDIES OF RENAL TRANSPLANTATION, OF THE SINGLE KIDNEY, AND OF OTHER STRESSES OF THE KIDNEY. Excerpta Med. Int. Congr. Ser.; No. 178, 393-408(1969).

From 1st International Symposium on Radioisotopes in the Diagnosis of Diseases of the Kidneys and the Urinary Tract, Liege, Belgium. See CONF-670667.

Four papers and two abstracts are presented. Investigations of functioning of renal transplants, mercury fixation, hemorrhagic shock effects of renal function, and renal and secondary blood disorders in relation to the use and value of information obtained through the use of radioisotopes are discussed. (C.O.)

34438 VARIOUS CLINICAL ASPECTS OF THE UTILIZATION OF RADIOISOTOPES IN UROLOGY. Excerpta Med. Int. Congr. Ser.; No. 178, 409-45(1969).

From 1st International Symposium on Radioisotopes in the Diagnosis of Diseases of the Kidneys and the Urinary Tract, Liege, Belgium. See CONF-670667.

Seven papers and three abstracts are presented concerning the diagnostic advantages and uses of isotopes in cases of bladder and kidney disease. Use in combination with other diagnostic studies, problems of drugs and water loading, and quantitative interpretation of data are among the topics considered. (C.O.)

34439 ISOTOPE RENOGRAM. Excerpta Med. Int. Congr. Ser.; No. 178, 449-540(1969).

From 1st International Symposium on Radioisotopes in the Diagnosis of Diseases of the Kidneys and the Urinary Tract, Liege, Belgium. See CONF-670667.

Fifteen papers and two abstracts are presented covering such topics as equipment, tracers, techniques, use of computers, physiological bases, renogram analysis, code of practice, and mathematical models. (C.O.)

34440 RENAL SCINTIGRAPHY. Excerpta Med. Int. Congr. Ser.; No. 178, 541-93(1969).

From 1st International Symposium on Radioisotopes in the Diagnosis of Diseases of the Kidneys and the Urinary Tract, Liege, Belgium. See CONF-670667.

Eight papers and four abstracts are presented. Included are consideration of renal scintiscanning in urological diagnosis; comparison with angiography, gammagraphy, and nephrotomography; and color scintigraphy. (C.O.)

34441 SCINTILLATION CAMERAS IN RENAL DIAGNOSIS. Excerpta Med. Int. Congr. Ser.; No. 178, 595-624(1969).

From 1st International Symposium on Radioisotopes in the Diagnosis of Diseases of the Kidneys and the Urinary Tract, Liege, Belgium. See CONF-670667.

Four papers and three abstracts are presented concerning the principles, techniques, and use of scintillation cameras in clinical kidney cases. (C.O.)

34442 THE RADIATION HAZARD OF RADIOISOTOPE EXAMINATIONS OF THE KIDNEYS AND THE URINARY TRACT. Excerpta Med. Int. Congr. Ser.; No. 178, 625-38(1969).

From 1st International Symposium on Radioisotopes in the Diagnosis of Diseases of the Kidneys and the Urinary Tract, Liege, Belgium. See CONF-670667.

Three papers and one abstract concerning radiation damage and hazards in the use of radioisotopes in diagnosis of diseases of the excretory system are presented. (C.O.)

34443 RADIOISOTOPES IN THE DIAGNOSIS OF DISEASES OF THE KIDNEYS AND THE URINARY TRACT. Proceedings of the First International Symposium, Liege, 22–25 June 1967. Timmermans, L.; Merchie, G. (eds.). International Congress Series No. 178. Amsterdam; Excerpta Medica Foundation (1969). 683p. $36.00. (CONF-670667).

Thirteen separate abstracts were prepared for each of the major sections of the symposium. In addition, nine abstracts of free communications are included. Both an author and a subject index are provided. (C.O.)

For abstracts of individual sections see: 34431–34442, and 34444.

34444 PHYSIOLOGICAL, PHARMACOLOGICAL, AND HISTOLOGICAL ASPECTS OF RENAL FUNCTION STUDIED BY RADIOISOTOPES. Excerpta Med. Int. Congr. Ser.; No. 178, 249-77(1969).

From 1st International Symposium on Radioisotopes in the Diagnosis of Diseases of the Kidneys and the Urinary Tract, Liege, Belgium. See CONF-670667.

Six papers and three abstracts are included in this section. Studies are presented on radioautography and the renogram; significance of segments of the isotope nephrogram; improvement of nephrogram through use of intravenous mannitol; effects of sucrose and mannitol against angiotensin II vasoconstriction in the kidney; effects of benziodarone on uric acid metabolism in cases of renal insufficiency; and a new method for divided renal plasma flow measurement. Abstracts are of papers concerning the effects of angiotensin on renograms; effects of pharmacological agents decreasing radiomercury retention in the kidneys; and effects of some hydroxybenzoyl benzofurans on the urinary tract. (C.O.)

34445 QUANTITATIVE COLOR SCINTIPHOTOGRAPHY WITH THE DIGITAL AUTOFLUOROSCOPE. Grossman, B. Lewis; Johnson, Philip M.; Wood, Ernest H. (Columbia Univ., New York. Columbia-Presbyterian Medical Center, New York). Radiology; 94: 529-33(Mar 1970).

A simple method for obtaining quantitative color scintiphotographs with the Baird Atomic Autofluoroscope, a high-speed multicrystal camera, is presented. Each color scintiphotograph presents a multifold increase in information content in comparison with conventional black-and-white scintiphotography. (auth)

34446 CEREBRAL TRANSIT OF PERTECHNETATE GIVEN INTRAVENOUSLY. Rosenthall, Leonard; Martin, Robert H. (Montreal General Hospital). Radiology; 94: 521-7(Mar 1970).

A quantitative analysis of 387 brain transit studies using ^{99}Tc-labeled pertechnetate is presented. The perfusion study was most useful in detecting the site of acute cerebrovascular accident and transient cerebral ischemia when the static study was negative. Perfusions were disparate in 12 to 27 per cent of cases in which the finding was not anticipated. The cerebral radiopertechnetate transit study did not improve the detection frequency of primary and secondary intracranial neoplasms. (C.H.)

34447 TOMOGRAPHIC TECHNIQUES IN RADIOISOTOPE IMAGING WITH A PROPOSAL OF A NEW DEVICE: THE TOMOSCANNER. Miraldi, Floro (Case Western Reserve Univ., Cleveland); Di Chiro, Giovanni. Contract PH-43-68-41. Radiology; 94: 513-20(Mar 1970).

Tomographic scanning with collimators inclined to the plane of interest is examined for resolution capability. Calculations are presented for inclined single conical channels and focusing collimators to demonstrate general characteristics of this method. Focusing collimator systems are shown to be a special case of the general method. Results of the general analysis led to the design of a new machine, the Tomoscanner, which utilizes a slit collimator combined with the concept of the hybrid scanner of Davis. The slit-hybrid collimator system is easily incorporated into a system capable of viewing many layers simultaneously. (auth)

34448 PANCREAS SCANNING. Rodriguez-Antunez, Antonio; Alfidi, Ralph J.; Gill, Wilfrid Jr. (Cleveland Clinic Foundation). CRC Crit. Rev. Radiol. Sci.; 1: 25-46(Jan 1970).

Biochemical properties of ^{75}Se methionine are discussed. The different protocol proposed for preparation of the patient prior to performing the scan is reviewed. The usefulness of simple as well as complicated scanning is also studied. Experience at the Cleveland Clinic with about 500 cases of pancreatic scans and the comparison of celiac arteriography and scan in about 150 are presented. (auth)

34449 INFORMATION SYSTEMS FOR DIAGNOSTIC RADIOLOGY. Uber, Gordon T. (Lockheed Information Systems, Sunnyvale, Calif.). CRC Crit. Rev. Radiol. Sci.; 1: 47-67(Jan 1970).

Information systems now being developed will expedite the processing of medical orders and reports. Pilot studies providing a direct interface between the radiologist and information systems are reviewed relative to the equipment and techniques used for the entry and retrieval of radiologic data. (auth)

34450 CINERADIOGRAPHIC EVALUATION OF PHARYNGEAL NEUROMUSCULAR DISORDERS. Silbiger, Martin L. (Tampa General Hospital, Fla.). CRC Crit. Rev. Radiol. Sci.; 1: 69-83(Jan 1970).

A review of recent developments in the cineradiographic evaluation of neurologic and muscular diseases affecting swallowing was undertaken. Specific disorders of deglutition in myotonic dystrophy are discussed. Emphasis on various manometric methods utilized in studying swallowing function is made and the technical advantages of continuous cinerecording is stressed. (auth)

34451 ^{99m}Tc LOCALIZATION IN THE CHOROID PLEXUS. Silberstein, Allen B.; Levy, Lester M. (Downstate Medical Center, Brooklyn). Radiology; 95: 529-32(Jun 1970).

Animal studies confirm the concentration of ^{99m}Tc in the choroid plexus and elucidate the mechanism involved. One group of rabbits received ^{99m}Tc intravenously and were sacrificed at different time intervals following injection, while a second group received intravenous potassium perchlorate before the technetium injection. At the time of sacrifice, the concentration of ^{99m}Tc in the choroid plexus samples exceeded that in samples of brain, serum, and cerebrospinal fluid. This preferential concentration of technetium was markedly curtailed in animals pretreated with potassium perchlorate. In the choroid plexus of the ventricles of the brain ^{99m}Tc is concentrated via an active transport mechanism. (auth)

34452 THE AUTOFLUOROSCOPE AND ^{133}Xe IN DYNAMIC STUDIES OF PULMONARY PERFUSION AND VENTILATION. Toffolo, R. Ronald; Beerel, Frederick R. (Millard Fillmore Hospital, Buffalo). Radiology; 94: 692-6(Mar 1970).

Rapid serial images of the lungs were obtained with gamma cameras during the intravenous administration of a ^{133}Xe solution. Areas of retarded inflow were indicated even though the eventual perfusion level was normal. Further serial images during breathing showed ventilatory washout of radioactive xenon gas from the perfused areas. Four cases of the 17 studies are illustrated. (auth)

34453 SIMULTANEOUS INVESTIGATIONS WITH TWO ISOTOPES BY MEANS OF THE ANGER TYPE SCINTILLATION CAMERA. Lange, D. (Univ., Heidelberg). Nucl.-Med.; 8: 375-86(31 Dec 1969). (In German).

By means of a simple electronic circuit both electronic equipments of Pho/Gamma II and Pho/Gamma III are connected simultaneously to the image detector of a scintillation camera. Investigations with phantoms of different image, one filled with ^{203}Hg and the other one with ^{131}I yielded well distinguishable pictures. Thus the double-isotope technique using the Anger camera is proposed for clinical routine. (auth)

34454 ATLAS OF NUCLEAR MEDICINE. VOLUME 1. BRAIN. DeLand, Frank H.; Wagner, Henry N. Jr. Philadelphia; W. B. Saunders Company (1969). 226p. $18.00.

The purpose of this atlas is to portray the images obtained by scanning, and to correlate them with anatomy and physiology. All patients whose case histories form the basis of this atlas presented as diagnostic problems. The format used throughout is to present first a brief statement of the clinical problem together with the diagnostic impression prior to the performance of the scan. Then a description of the scan is given followed by its interpretation. Included are sections on normal anatomy, normal variants, unusual variants, congenital abnormalities, infectious diseases, eosinophilic granuloma, trauma, cerebrovascular diseases, circulatory diseases, tumors, diseases of the skull, diseases of the scalp, and cisternography. A subject index is provided. (C.O.)

34455 PLACENTAL LOCALIZATION WITH INDIUM SCANNING. Andrews, J. T.; Arkles, L. B.; Steven, L. W. (Royal Melbourne Hospital). Med. J. Aust.; 1: 220-2(31 Jan 1970).

Radioisotope scanning of the placenta, using ^{113m}In as a blood pool label is discussed. Ease of isotope preparation, and relatively low fetal body-dose of approximately 8 mrad/mCi of ^{113m}In administered to the mother, are advanced as advantages over corresponding radiographic procedures. (Australia)

34456 MICROVASCULAR CIRCULATION OF THE LUNGS IN EMPHYSEMA: CORRELATION OF RESULTS OBTAINED WITH ROENTGENOLOGIC AND RADIOACTIVE-ISOTOPE TECHNIQUES. Levant, M. N.; Bass, H.; Anthonisend, N.; Fraser, R. G. (Royal Victoria Hospital, Montreal). J. Can. Ass. Radiol.; 14: 130-4 (Sep 1968).

The degree of tomographic greyness as a measure of microvascular circulation of the lung parenchyma was studied in 17 patients with pulmonary emphysema; this parameter was correlated with regional perfusion determined by ^{133}Xe techniques in all cases and by angiography also in six. Tomographic greyness and angiographic microvascular blush correlated well in lung zones with normal, reduced, or markedly diminished microvascular circulation; correlation of these parameters with ^{133}Xe perfusion indices was good in severely affected zones but showed agreement only on general pattern in others. It is considered that the degree of greyness of lung parenchyma on full-chest tomograms reflects the microvascular blood content of lung tissue. (auth) (Canada)

34457 MUON AS A TOOL FOR SCANNING THE INTERIOR OF THE HUMAN BODY. Daniel, H. (Technische Hochschule, Munich). Nucl.-Med.; 8: 311-19(31 Dec 1969).

A completely new technique for scanning the interior of the human body is presented. It is based on the following principle: muons from an accelerator pass through two spark chambers and are stopped in the body. The decay electrons leave the body and pass also two spark chambers. The trajectory coordinates read out from the spark chambers allow the determination of the point of decay with high precision. The truly three-dimensional picture obtained in this way is three-dimensionally displayed on a screen. Several modifications of the basic method are described, the most important ones being the simultaneous recording of the muonic x-rays, equivalent to a chemical analysis, or of the muon precision. The necessary dose is low. The most serious disadvantage is the need of a medium-energy accelerator. Quantitative figures on resolution, efficiency, and dose are given. (auth)

34458 DIAGNOSIS OF MALIGNANT TUMOR WITH ^{67}Ga-CITRATE. I. Higasi, Tomomitu; Nakayama, Yosiyuki; Ikemoto, Igaku; 6: 217-26(Sep 1969). (In Japanese).

Gallium-67 citrate was administered intravenously to patients with cancer of various organs of the body. Forty-eight hrs later scintigraphy and a catheter type semiconductor detector were used for detection. Satisfactory results were obtained in cases of cancer of the lung, heart, and paranasal cavity. In cases of cancer of the stomach and uterus the semiconductor detector gave much better results than the scintigram. (auth)

34459 PROCEDURE FOR THE QUANTITATIVE DETERMINATION OF THE OSSEOUS MINERAL CONTENT USING RADIOISOTOPES. Strueter, H.-D.; Rassow, J. (Ruhruniversitaet, Essen). Fortschr. Geb. Roentgenstr. Nuklearmed.; 110: 499-506(1969). (In German).

The usefulness of available methods for early estimation of bone calcium loss is evaluated. The best method, with regard to ease of application and accuracy, is a new method using radioactive isotopes and a scintillation counter as detector. An accurate quantitative estimation of all possible sources of error is carried out. The results are shown in the form of diagrams and tables and permit rapid and exact estimation, without further calculations, of the accuracy, using any desired photon energy, activity (impulse frequency), and thickness of bone and skin. By this means optimal results are possible. The presupposition for the use of this method is an accurate correlation between reduction in beam intensity and mineral concentration. Energy discrimination of gamma-quanta eliminates the effect of scatter. (auth)

34460 NEW RADIONUCLIDES. Boyd, R. E. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Australas. Radiol.; 14: 92-3(Feb 1970).

Physical properties of ^{99m}Tc and ^{18}F are tabulated. The ^{99m}Tc radionuclides is the best for scanning the brain, lungs and reticuloendothelial system and ^{18}F the best for scanning the skeleton. It is hoped to extend the applications of ^{99m}Tc to the scanning of parathyroid, pancreas, and other areas. (auth) (Australia)

34461 DETAILS OF RADIOIODINE DIAGNOSTICS AND INDICATIONS FOR SURGERY SOLITARY AND MULTIPLE ADENOMAS OF THE JUVENILE THYROID GLAND. Thiemann, K. J.; Bay, V. Arch. Klin. Chir.; 322: 1223-7(1968). (In German).

Typical changes in ^{131}I metabolism observed in 45 children with juvenile thyroid adenoma were discussed. Only 4 inactive adenomas failed to take up ^{131}I and uptake was less than normal in most of the others. Turnover of ^{131}I was increased, but hyperthyroidism generally was not observed. Autonomous toxic adenomas observed in the children were not affected by thyroid hormone treatment, but after removal of the adenoma ^{131}I function was normal. The adenomas usually appeared between ages 11 to 13. In cases where decompensated adenomas had been present for 5 yr, slight hyperfunction was observed with ^{131}I following removal of the adenomas. No changes in ^{131}I turnover were observed with inactive thyroid cysts or inactive adenomas. Out of 90 nodes whose ^{131}I uptake was below normal 2 were malignant. Solitary cold nodes with increased ^{131}I turnover and other nodes with decreased ^{131}I turnover were considered to be possibly malignant. (BBB)

34462 SPLEEN SCANNING. McCready, V. Ralph; Ahuja, S. (Royal Cancer Hospital, Sutton, Eng.). Proc. Roy. Soc. Med.; 62: 794-6(Aug 1969).

Several methods available for demonstrating the spleen scintigraphically were discussed. These included the heat denaturation of labeled autologous red blood cells, the use of 3-bromomercuri-2-hydroxypropane (BMHP) labeled with ^{197}Hg, the coating of labeled red blood cells with Rh antibodies, the ^{198}Au, ^{99m}Tc or ^{113m}In colloids used for liver scanning, and the use of the short-lived isotope ^{81}Rb as a label with denaturation of the red blood cells by BMHP. The ^{51}Cr-heat denaturation method was convenient to use but the quality of the scans was poor because of the low activity generally used. When ^{197}Hg-neohydrin was used in higher activities the quality of the scans was better, and the technique was rapid and simple, but the short shelf-life of ^{197}Hg was a disadvantage. The ^{99m}Tc-sulfur or ^{113m}In colloids were useful when used in conjunction with liver scanning. However, often it was difficult to separate the organs completely even with multiple views. The rectilinear scanner and the advantages and disadvantages of camera were compared. The scanner had the advantage of producing life-size images and accurate measurements of the spleen size. The indications for spleen scanning included the determination of the position of the organ and its size, the demonstration of space-occupying lesions such as cysts, abscesses or tumors, and confirmation of the presence of infarction. The technique was particularly useful in the differential diagnosis of masses in the left hypochondrium and to distinguish renal and splenic masses. Where accurate measurement of the size of the spleen was not needed, a γ camera scintigram following ^{99m}Tc or ^{113m}In colloid gave an indication of the size and tumor involvement in a few seconds. Tumors, cysts, and infarcts were seen as areas of reduced activity. With the ^{51}Cr method it was difficult to detect diffuse abnormalities and circumscribed space-occupying lesions of less than 3 cm in diameter could not be seen. With short-lived isotopes the results were somewhat better. (BBB)

34463 RADIOACTIVE XENON TISSUE CLEARANCE: STANDARDIZATION FOR MEASUREMENT OF PERIPHERAL BLOOD FLOW. Corman, L. Andre; Flickinger, Frederick W.; Sokoloff, Joel; Nodine, John H. (Hahnemann Medical Coll. and Hospital, Philadelphia). J. Nucl. Med.; 11: 233-8(Jun 1970).

In comparing blood-flow measurements following intramuscular ^{133}Xe injection under various conditions with standaridized treadmill walking distances, correlation was observed among several of the explored parameters. The availability of this technique and its computerization for efficient data handling lets one undertake a more comprehensive investigation under various physiologic and pharmacologic conditions, follow laboratory changes, and relate them to the clinical course of the disease as estimated by conventional measures. Wider application of the ^{133}Xe technique in clinical and pharmacologic studies is recommended. With the proper computerized support, the technique is practicable for general clinical diagnostic use and is capable of making blood-perfusion measurements which otherwise would require exposure of vessels. (auth)

34464 EVALUATION OF THE RELIABILITY OF RADIOLOGICAL METHODS FOR REGISTRATION OF SCOLIOSIS. Sevastikoglou, J. A.; Bergquist, E. (Univ. Hospital, Uppsala). Acta Orthop. Scand.; 40: 608-13(1969).

An evaluation of the results obtained by consecutive measurements on x-ray films of an unchanged scoliotic deformity of the spine by Ferguson's and Cobb's methods was performed. It was found that minor rotations of the spine as well as movements of the x-ray tube or a combination of both do not influence the results of reading in an appreciable degree whether Ferguson's or Cobb's method is used. The margins of error of the numerical measurements of the scoliotic curve on x-ray films are, however, relatively small, i.e., $1.82 \pm 0.21°$ for Ferguson's and $3.12 \pm 0.48°$ for Cobb's method. Measurements performed by Cobb's method gave consistently higher values than those performed by Ferguson's method: the differences ranging between 4 and 16°, mean values $7.84 \pm 0.51°$. There were, however, no appreciable differences between measurements performed by the two methods. (auth)

34465 SCANNING OF THE LUNG. Walker, R. H. Secker; Jackson, Judy A. (University Coll. Hospital, London). Proc. Roy. Soc. Med.; 62: 794-804(Aug 1969).

The use of scanning in the demonstration of pulmonary arterial perfusion was discussed. The method for preparation of ^{99m}Tc-labeled macroaggregated human serum albumin (^{99m}Tc-MAA) and the scanning procedure are described. After injection the particles become impacted in the small pulmonary arterioles and capillaries and their distribution is proportional to pulmonary arterial blood flow at the time of injection. The particles steadily disintegrate and pass through the lungs to be removed from the circulation by the liver and spleen. With 2 mCi ^{99m}Tc-MAA the radiation received by the lungs is ~300 mRad. Handling the data in digital form allows correction for the physical decay of short-lived isotopes, background subtraction, statistical analyses and reproduction of the scans in a variety of ways. Resolution can be improved by eliminating scalloping at the scan edges, smoothing the unevenness at low count rates, and correcting the data to correspond with the response characteristic of the collimator used. The distribution of activity at any level of the maximum count rate can be displayed, offering a means of contrast enhancement over much smaller ranges than is possible with either colorscans or photoscans. In addition, a comparison of the total counts in each lung, of the profiles of the counts per row, and of the areas of each lung at different levels of the maximum count rate can be made. (BBB)

34466 SIGNIFICANCE OF INCREASED SPLENIC UPTAKE ON LIVER SCINTISCANNING. Eddleston, A. L. W. F.; Blendis, L. M.; Osborn, S. B.; Williams, Roger (King's Coll. Hospital, London). Gut; 10: 711-16(Sep 1969).

Use of ^{99m}Tc-labeled sulfur colloid for liver scanning in 265 patients is described. A 1-mCi dose of ^{99m}Tc sulfur colloid was prepared, injected intravenously, and starting 20 min later the liver and spleen areas were scanned, with the patient supine, using a 5-in. coarse focus collimator. The peak count rate over the liver

in most cases was in the range 30,000 to 80,000 cpm. On the basis of count rates over the spleen and liver, the peak activity over the spleen was expressed as a percentage of the peak activity over the liver. The range of this value in patients finally found to have no evidence of disease involving the liver or spleen was 0 to 35%. Activity over the spleen was moderately increased (35 to 70%) in many scans. Peak activity over the spleen of more than 70% of peak activity over the liver was present in 50 of the 265 scans. These included 32 of 54 cases with cirrhosis, but marked activity over the spleen was also found in a wide variety of other conditions, such as Hodgkin's disease, Gaucher's disease, Felty's syndrome, hepatitis, and polycythemia rubra vera. A measure of the total activity in the spleen was derived from the peak activity and the length of the spleen. In cirrhosis this was closely related to the finding of esophageal varices thus showing the importance of a collateral circulation (which allows colloid to bypass the liver) in the increased uptake of colloid by the spleen. The results showed that the main factor causing increased uptake of ^{99m}Tc colloid by the spleen in these diseases was an increased blood flow in the spleen relative to that in the liver. (BBB)

34467 BRAIN SCANNING WITH ^{99m}Tc: PRELIMINARY RESULTS. Robert, J.; Mantaut, J.; Picard, L.; Naoun, A.; Lepoire, J. (Hopital Saint Julien, Nancy. Faculte de Medecine, Nancy). Neuro-Chir.; 15: No. 5, 379-88(1969). (In French).

In a preliminary series 350 brain-scans using technetium-99 were performed. A high percentage of surgically verified tumors was accurately shown by this sort of examination. With the help of two scans, performed at the first and sixth hours after technetium administration, the histological features of the lesion were predictable in some cases. (auth)

34468 SCINTIGRAPHY IN LUNG CANCER DIAGNOSTICS. Ala-Ketola, L. Duodecim; 86: No. 2, 91-7(1970). (In Finnish).

A presentation is made of thirty cases of suspected or verified malignant lung tumors examined by x ray and scintigraphy with ^{131}I-labeled macroaggregated human serum albumin. The presence of the tumor was demonstrable by both methods in 21 cases, whereas scintigraphy failed in two x-ray positive cases. Centrally situated tumors that readily induce alterations in the pulmonary blood flow, are more readily demonstrated by scintigraphy. (auth) (Finland)

34469 CEREBRAL GAMMOGRAPHY WITH ^{99m}Tc. Jasinski, W.; Malinowska, J.; Pilipowska, T.; Mackiewicz, H.; Sierpinski, S. (Inst. of Oncology, Warsaw). Neurol, Neurochir. Psychiat. Pol.; 2: 191-8(Mar-Apr 1968). (In Polish).

Five instances in which ^{99m}Tc-pertechnetate was used to diagnose primary or metastatic tumors in brain are described and results in a total of 44 patients are summarized. Such a γ encephalographic diagnosis of brain diseases depends on the damage to the blood-brain barrier, which under normal conditions prevents the radioisotope circulating in the blood from accumulating in the central nervous system. When focal changes in the brain occur, this barrier may be damaged, with resulting selective concentration of radioactive substances in the damaged tissue, which makes possible its visualization. Damage to the barrier occurs independently of the nature of the pathological process so that γ encephalography is a nonspecific method; that is, it cannot reveal the nature of the pathological process causing the appearance of a hot spot in the γ encephalogram. Technetium-99m is accumulated readily in the tissues of various neoplasms and allows recognition of them in γ encephalograms. The diagnostic method using ^{99m}Tc is particularly valuable because it is technically simple and is safe, causing no discomfort to the patient. It causes only a negligible radiation exposure of the patient and physician and it is rapid. In many cases, positive results of the isotope investigation are of decisive importance, avoiding the necessity of performing further investigations which are not free of risk (angiography and pneumoencephalography). (BBB)

34470 RADIOACTIVE ISOTOPES IN THE LOCALIZATION OF TUMOURS. Proceedings of the International Nuclear Medicine Symposium, Held at London, September 1967. McCready, V. R.; Taylor, D. M.; Trott, N. G.; Cameron, C. B.; Field, E. O.; French, Rosemary J.; Parker, R. P. (eds.). London; William Heinemann Medical Books Ltd. (1969). 191p. 80s. (CONF-670948).

Abstracts were prepared for 39 individual papers. The symposium was divided into the following parts: physical aspects; (reviews of instruments); radioactive materials in the investigation of tumors; clinical aspects; thyroid and parathyroid; bone; soft tissues; and brain tumors. (UK)

For abstracts of individual papers see: 33896–33900, 33970, and 34471–34503.

34471 PRINCIPLES OF SCANNING AND CURRENT PHYSICAL PROBLEMS. Mallard, J. R. (Univ. of Aberdeen, Scotland). pp 1-6 of Radioactive Isotopes in the Localization of Tumours. /McCready, V. R. (ed.). London; William Heinemann Medical Books Ltd. (1969).

From Symposium on Radioactive Isotopes in the Localization of Tumours, London, England. See CONF-670948.

The author defines the scanning problem as the difficulty of determining and reproducing in a visual way the γ ray flux pattern produced at the surface of the body, from a complex distribution of radioactivity inside the body. The paper is an outline review of current display and visualization systems, and the possibilities of manipulating displayed information by computer, to produce a compromise between sensitivity and resolution. (UK)

34472 MEDICAL POTENTIALITES OF SMALL CYCLOTRONS. Silvester, D. J. (Hammersmith Hospital, London). pp 7-10 of Radioactive Isotopes in the Localization of Tumours. /McCready, V. R. (ed.). London; William Heinemann Medical Books Ltd. (1969).

From Symposium on Radioactive Isotopes in the Localization of Tumours, London, England. See CONF-670948.

The author briefly restates the arguments which persuaded the Medical Research Council to build its own cyclotron at Hammersmith Hospital. The main body of the paper discusses the question of isotope production. A cyclotron can make a wide range of isotopes that cannot be made with a nuclear reactor. Cyclotron produced isotopes have a very much higher specific activity than reactor produced ones. The potential medical uses of the following radioisotopes are discussed: Oxygen-15, Carbon-11, Fluorine-18, Rubidium-81, Iron-52, Iodine-123, Yttrium-87. (UK)

34473 MECHANICAL SCANNING. Trott, N. G. (Royal Marsden Hospital, London). pp 11-15 of Radioactive Isotopes in the Localization of Tumours. /McCready, V. R. (ed.). London; William Heinemann Medical Books Ltd. (1969).

From Symposium on Radioactive Isotopes in the Localization of Tumours, London, England. See CONF-670948.

The papers presented in this rapporteur review are divided into two sections. In the first section, experience gained by Weight, and by Boss Eversden and Perry, using the dual detector scanner made by Societa Elettronica Lombarda was described. Weight described the design and general performance of the instrument. The other authors carried out detailed studies of performance using technettium in the detection of brain tumours. In the second section a dual detector scanner built specially for brain tumor localisation with low energy γ-emitters was described by Wills, and certain considerations in the design and development of scanners were considered by McAlister Hawkins and Cato in one paper, and Follet in another. (UK)

34474 INVESTIGATIONS OF COLLIMATOR PERFORMANCE. Hine, G. J. (International Atomic Energy Agency, Vienna). pp 26-36 of Radioactive Isotopes in the Localization of Tumours. /McCready, V. R. (ed.). London; William Heinemann Medical Books Ltd. (1969).

From Symposium on Radioactive Isotopes in the Localization of Tumours, London, England. See CONF-670948.

A collimator system may be designed to achieve optimum performance for a particular scanning problem, or to offer a good compromise for the scanning of many body sites with a variety of radionuclides. The papers presented in this rapporteur review describe examples of both types. Papers reviewed are as follows: (A) D. H. Follet. Collimator design for ^{99m}Tc brain tumour localisation. (B) Christine M. E. Matthews and Pamela M. Kibby. Effect of collimator resolution on the detection of lesions in brain scanning. (C) D. H. Follet and D. Jenkins. Scatter effects in scanning with low energy photons. (D) D. H. Follet. Automatic plotting of collimator response to point source with a colour scanner. (E) G. J. Hine. Comparison of scanners using one or multiple 3-in. or 5-in. diameter NAI(Tl) crystals. (UK)

34475 CAMERAS AND OTHER IMAGING DEVICES. Westerman, B. (Hammersmith Hospital, London). pp 37-41 of Radioactive Isotopes in the Localization of Tumours. /McCready, V. R. (ed.). London; William Heinemann Medical Books Ltd. (1969).

From Symposium on Radioactive Isotopes in the Localization of Tumours, London, England. See CONF-670948.

The papers described in this rapporteur review are concerned with various aspects of performance in relation to speed of clinical use. The papers briefly described are as follows: B. Roos and H. Skoldborn (Gothenburg, Sweden), An experimental comparison of the resolution of two gamma cameras (Frueseke & Hoffner Scanner and Nuclear Chicago Cameras), the Picker Dynapix and Picker Magnascanner; D. Jovanovic and A. Keyeux (Lourain,

Belgium), Our experience with a scintillation camera in cancer diagnostics; R. J. Wilks (Aberdeen, Scotland), A small angle type gamma camera with high uniformity; A. E. Todd-Pokropek and E. S. Williams (London), Studies on a simple approach to the visualisation of radioisotopes in vivo; and R. J. Wilks and J. R. Mallard (Aberdeen, Scotland), An image intensifier gamma camera of high resolution. (UK)

34476 CLINICAL APPLICATIONS OF AN IMAGE CONVERTER TUBE GAMMA CAMERA. Sodee, D. B. (Doctors Hospital and Renner Clinic Foundation, Cleveland). pp 46-9 of Radioactive Isotopes in the Localization of Tumours. /McCready, V. R. (ed.). London: William Heinemann Medical Books Ltd. (1969).

From Symposium on Radioactive Isotopes in the Localization of Tumours, London, England. See CONF-670948.

A prototype Picker Magnacamera is described briefly. It is composed of (1) A multihole collimator (2) A high gain image converter tube coupled to (3) an orthicon television chain. The clinical valuation indicated the Magnacamera to have limited applications in static organ studies, but potential significant value in dynamic image studies. The main problem of noise of image conversion tubes was not apparent. (UK)

34477 DISPLAY AND ANALYSIS. Parker, R. P. (Inst. of Cancer Research, Surrey, Eng.). pp 50-5 of Radioactive Isotopes in the Localization of Tumours. /McCready, V. R. (ed.). London: William Heinemann Medical Books Ltd. (1969).

From Symposium on Radioactive Isotopes in the Localization of Tumours, London, England. See CONF-670948.

A brief rapporteur review of seven papers. The following papers are mentioned: (a) Jocelyn Cato, Joan M. McAlister, V. E. Price, L. A. Hawkins (London). Analysis of Tc-99m brain scans by computer. (b) J. S. Clifton, E. J. Potchen and R. L. Hill (St. Louis, U.S.A.). A digital data acquisition system for nuclear medicine. (c) D. H. Fallett and D. Jenkins (Bristol, England). A variable time-constant circuit for improving colour and other ratemeter-derived brain scan delays. (d) R. Hofer, A. Kozak, G. Grabner, M. Del Bianco (Vienna). Difference scanning of brain tumours. (e) C. J. Peachey (Reading, England) A new development in colour data presentation from body scanners. (f) L. H. M. van Stekelenberg, (Arnham, Netherlands). Quantitative radioisotope scanning. (g) A. Todd-Pokropek (London). Development of a system of analysis using a digital computer for the radioisotope scan. (UK)

34478 TUMOUR LOCALIZATION BY SCINTISCANNING TECHNIQUE: DIGITAL COMPUTER PROCESSING. Tauxe, W. Newlon (Mayo Clinic, Rochester, Minn.). pp 63-8 of Radioactive Isotopes in the Localization of Tumours. /McCready, V. R. (ed.). London: William Heinemarn Medical Books Ltd. (1969).

From Symposium on Radioactive Isotopes in the Localization of Tumours, London, England. See CONF-670948.

The method of digital computer processing briefly described proved superior to the photoscan. The computer process was of value in increasing resolution at relatively low count rates to the point of providing clinically useful information in the thyroid gland containing as little as 0.8 μ Ci of I-131. Scans of lungs, liver, brain and kidneys were also carried out. (UK)

34479 UNIVERSAL MULTIFUNCTION COMPUTER INTERFACE SYSTEM FOR RECTILINEAR SCANNERS. Smith, E. M.; Katchis, L. (Univ. of Miami, Florida. Florida Power and Light Co., Miami). pp 69-72 of Radioactive Isotopes in the Localization of Tumours. /McCready, V. R. (ed.). London: William Heinemann Medical Books Ltd. (1969).

From Symposium on Radioactive Isotopes in the Localization of Tumours, London, England. See CONF-670948.

A second generation computer interface system has been developed to transform information output from a commercial multicrystal rectilinear scanning system, to a data format suitable for digital computer processing. In addition to the basic data transformation function of the interface, a means was provided of sensing pre-set anatomical landmarks, patent and procedure, identification data being entered on magnetic tape. A Kennedy half-inch 7 channel incremental magnetic tape recorder was used. Computer programs were written in Fortran IV. (UK)

34480 RADIOPHARMACEUTICALS FOR TUMOUR LOCALIZATION. Taylor, D. M. (Inst. of Cancer Research, Surrey, Eng.). pp 73-9 of Radioactive Isotopes in the Localization of Tumours. /McCready, V. R. (ed.). London: William Heinemann Medical Books Ltd. (1969).

From Symposium on Radioactive Isotopes in the Localization of Tumours, London, England. See CONF-670948.

This rapporteur reviews some attempts to achieve useful positive uptake of radioactive compounds in tumours, for the purpose of diagnosis. The emphasis is on the value of the radioactive compounds and not on scanning procedures. The papers mentioned are as follows: (A) N. B. Ackerman (Boston, U.S.A.) Experimental investigations on localisation of aminoacridines in tumours including preliminary studies with a radioiodinated form. (B) H. J. Altenbunn, A. Dressler, P. Georgi, H. Herzmann, G. Pasternak, L. Steenbeck, R. Vogt (Berlin Germany). Biological possibilities for a positive scan of tumours. (Labelled tumour antibodies.) (C) K. E. Britton and D. Keeling (London, England). The use of ^{75}Se-selenomethionine in the detection of malignant reticuloses. (D) R. R. Cavalieri and K. G. Scott (San Francisco, U.S.A.) Selenite $^{-75}$Se as a tumour localizing agent in man. (E) R. Isaac and C. Taynaud (Orsay, France). Scanning detection of tumours of the lungs, neck and head using $^{197}HgCl_2$. (UK)

34481 DISTRIBUTION OF RADIONUCLIDE-LABELLED PROTEINS IN AN EXPERIMENTAL TUMOUR SYSTEM. Bonte, F. J.; Curry, T. S. (Univ. of Texas, Dallas). pp 80-2 of Radioactive Isotopes in the Localization of Tumours. /McCready, V. R. (ed.). London: William Heinemann Medical Books Ltd. (1969).

From Symposium on Radioactive Isotopes in the Localization of Tumours, London, England. See CONF-670948.

A brief account is given of a study of labelled serum albumin distribution in an experimental tumour system. This consisted of transplants of V2 squamous cell carcinoma in the legs of a strain of albino laboratory rabbits. The results obtained suggest that the times for scanning tumors for uptake of labelled compounds varies according to the structure and location of the tumor. (UK)

34482 CURRENT TECHNIQUES EMPLOYING REGIONAL OXYGENATION AS A MEANS TO ENHANCE THE LOCALIZATION OF RADIOISOTOPES IN BRAIN TUMORS. Faust, D. S.; Brady, L. W.; Croll, M. N.; Kazem, I. (Hahnemann Medical Coll., Philadelphia). pp 83-6 of Radioactive Isotopes in the Localization of Tumours. /McCready, V. R. (ed.). London: William Heinemann Medical Books Ltd. (1969).

From Symposium on Radioactive Isotopes in the Localization of Tumours, London, England. See CONF-670948.

The paper reviews experience with 30 cases studied by the hydrogen peroxide infusion technique over two and a half years, but does not give detailed presentation of methods and materials. The authors include figures showing comparison of conventional brain scanning with the scanning after regional oxygenation technique in the same patient. (UK)

34483 RECENT DEVELOPMENTS IN NEW AGENTS, INSTRUMENTATION, AND TECHNIQUES FOR TUMOR LOCALIZATION. Tubis, M.; Crandall, P. H.; Cassen, B.; Blahd, W. H. (Veterans Administration Center, Los Angeles). pp 87-91 of Radioactive Isotopes in the Localization of Tumours. /McCready, V. R. (ed.). London: William Heinemann Medical Books Ltd. (1969).

From Symposium on Radioactive Isotopes in the Localization of Tumours, London, England. See CONF-670948.

The following topics are briefly reviewed. (1) The preparation and use of orthoradioiodobenzoic acid ^{131}I for liver scanning. (2) The preparation and use of sodium sulphobromophthalein ^{131}I for liver scanning. (3) Technetium-99m labelled compounds for possible pancreas and other organ scanning. (4) Labelling cystine, methionine, and synthetic secretin. (5) Tetracycline chelates as potential scanning agents. (6) High speed section scanning using the previously mentioned compounds. The instrument was designed by Crandall and Cassen 1966. (UK)

34484 ^{197}Hg CHLORMERODRIN IN THE LOCALIZATION OF EXTRA CRANIAL TUMORS. Sodee, D. B. (Doctors Hospital and Renner Clinic Foundation, Cleveland). pp 92-4 of Radioactive Isotopes in the Localization of Tumours. /McCready, V. R. (ed.). London: William Heinemann Medical Books Ltd. (1969).

From Symposium on Radioactive Isotopes in the Localization of Tumours, London, England. See CONF-670948.

It has been found that ^{197}Hg-chlormerodrin localizes extracranial tumors. The authors had the best results in the localization of primary and secondary tumors of the lung. A brief illustrated review is given of tumor localizations using ^{197}Hg-chlormerodrin in 128 patients. Instruments used for scanning included a 5 × 2 in. crystal photoscanner with printer and three 3 × 2 in. sodium iodide crystal photoscanners. Standard well counters, macro- and microautography techniques were also used. (UK)

34485 THE USE OF A TRIGA REACTOR IN A NUCLEAR MEDICAL DEPARTMENT. Lorenz, W. J.; Scheer, K. E. (German Cancer Research Centre, Heidelberg). pp 95-8 of Radioactive Isotopes in the Localization of Tumours. /McCready, V. R. (ed.). London: William Heinemann Medical Books Ltd. (1969).

From Symposium on Radioactive Isotopes in the Localization of Tumours, London, England. See CONF-670948.

The TRIGA Mark I reactor at the German Cancer Research Center in Heidelburg is described briefly together with its adjacent facilities for nuclear medical research. Applications include the following: production of short-lived isotopes; neutron activation analysis: stable tracer studies followed by activation analysis; radiation biology; neutron dosimetry; and neutron autoradiography. (UK)

34486 EXAMINATION OF THYROID CARCINOMA. Pochin, E. E. (University Coll. Hospital Medical School, London). pp 99-102 of Radioactive Isotopes in the Localization of Tumours. /McCready, V. R. (ed.). London: William Heinemann Medical Books Ltd. (1969).

From Symposium on Radioactive Isotopes in the Localization of Tumours, London, England. See CONF-670948.

The value of radioiodine studies in a diagnostic role is restricted by the infrequency with which thyroid cancer tissue concentrates well, or even at all in the presence of functioning normal thyroid tissue. Of a group of fifty thyroid cancers which ultimately developed good radioiodine uptake, in only one third was such uptake demonstrable before ablation of normal thyroid tissue. The author therefore argues that when a metastasis of unknown origin is detected, an examination of its radioiodine uptake would be worth making; the occasional detection of an iodine concentrating tumor would offer possible treatment. Any clear indication that the thyroid was a primary site might be held to justify a thyroid ablation, more definitive tests and treatment being possible afterwards. (UK)

34487 THYROID AND PARATHYROID. Hoefer, R.; French, R. J. (Medical Univ. Clinic, Vienna. Royal Marsden Hospital, Surrey, Eng.). pp 103-6 of Radioactive Isotopes in the Localisation of Tumours. /McCready, V. R. (ed.). London: William Heinemann Medical Books Ltd. (1969).

From Symposium on Radioactive Isotopes in the Localization of Tumours, London, England. See CONF-670948.

The following papers are reviewed: J. S. Garrow (London), The detection of parathyroid tumors by ^{75}Se-selenomethionine scanning; W. H. Clode, A. M. Baptista (Lisbon, Portugal), Evaluation of a quantitative system in thyroid scanning; E. Robinson, A. Hochman (Jerusalem, Israel), Scanning in diagnosis and in evaluation of cancer therapy (use of iodine 131 to evaluate the effects of therapy on metastases to the lungs from carcinoma of the thyroid; C. F. Barnaby, C. J. Edmonds, T. Smith (London), Large area whole-body counting and their use in thyroid carcinoma investigations. (UK)

34488 CONTRIBUTION OF SUPPRESSION SCANNING TO EVALUATION OF THYROID NODULES FOR CANCER. Hamburger, J. I. (Highland Park General Hospital, Mich.). pp 107-13 of Radioactive Isotopes in the Localization of Tumours. /McCready, V. R. (ed.). London: William Heinemann Medical Books Ltd. (1969).

From Symposium on Radioactive Isotopes in the Localization of Tumours, London, England. See CONF-670948.

This report offers a classification of thyroid nodules based on a functional interpretation of scan data using iodine-131. Suppression scanning was performed for patients with nondelineated nodules or with functional nodules when the extent of function was not clear. This was done after the administration of L-thyroxine 0.3 mg daily for four weeks. If the repeat scan revealed suppression of extranodular ^{131}I concentration, with persistent nodular activity, then autonomous function was confirmed. If uniform suppression of uptake occurred, the nodule remained nondelineated. Of 590 nodules, 68 were nondelineated, 153 functional, and 369 hypofunctional. Suppression scanning confirmed autonomous function in 8 nondelineated nodules, and was of value in clarifying the extent of function in 22 functional nodules. (UK)

34489 PARATHYROID SCINTISCANNING: PROGRESS AND PROBLEMS. Potchen, E. J.; Clifton, J. (Washington Univ., St. Louis). pp 114-16 of Radioactive Isotopes in the Localization of Tumours. /McCready, V. R. (ed.). London: William Heinemann Medical Books Ltd. (1969).

From Symposium on Radioactive Isotopes in the Localization of Tumours, London, England. See CONF-670948.

The selenomethionine parathyroid scan was initially based on the premise that a gamma-emitting amino acid analogue would be incorporated in protein and could be identified in greater concentration in the hyperactive tissue than in surrounding structures. Following animal investigations, a series of scintiscans were performed on patients with hyperparathyroidism, as a preoperative procedure. The technique, while frequently helpful, proved limited by the diffuse distribution of the radioactive label, and lack of a thorough understanding of the kinetics of parathyroid amino acid secretion. (UK)

34490 BONE SCANNING. McCready, V. R. (Royal Cancer Hospital, Surrey, Eng.). pp 117-21 of Radioactive Isotopes in the Localization of Tumours. /McCready, V. R. (ed.). London: William Heinemann Medical Books Ltd. (1969).

From Symposium on Radioactive Isotopes in the Localization of Tumours, London, England. See CONF-670948.

The following papers are briefly summarized: D. G. Bratheston, A. M. Maysent (Cambridge, England) on the use of strontium-87m in bone scanning; A. Centi Collella, F. Pigorinini (Rome, Italy) on detection of bone neoplasms by scanning; biological factors affecting the uptake of bone-seeking; and C. L. Harmer, J. E. Burns, A. Sams, M. Spittle (London) on a clinical evaluation of bone scanning using fluorine. It was concluded that: the main factor in strontium uptake in bone tumors is probably related to the degree of reaction of the bone surrounding the tumor; fast growing tumors show least reaction and have low uptake; bone scans are useful in detecting early metastases, in defining areas for further X-ray examination, in determining the extent of treatment fields, and in following the effectiveness of treatment; the short lived isotopes ^{18}F and ^{87m}Sr are especially useful for bone scanning because of reduced radiation hazards, the increased speed of scanning and ability to scan soon after the administration of the isotope. (UK)

34491 DETECTION OF OCCULT BONE METASTASES OF BREAST CANCER AT THE TIME OF RADICAL MASTECTOMY BY PHOTOSCANNING WITH ^{85}Sr. Sklaroff, D. M.; Charkes, N. D. (Albert Einstein Medical Centre, Philadelphia). pp 122-7 of Radioactive Isotopes in the Localization of Tumours. /McCready, V. R. (ed.). London: William Heinemann Medical Books Ltd. (1969).

From Symposium on Radioactive Isotopes in the Localization of Tumours, London, England. See CONF-670948.

Sixty-four women who had just had radical mastectomy for cancer, and had positive axillary nodes were scanned with Sr-85. In ten patients, the scan was abnormal, although the corresponding roentgenogram was normal. Roentgenograms subsequently became abnormal in only two of the ten although in seven patients the follow up time was five to thirteen months. Four of the ten patients died, all with bone metastasis, but only one of these had positive roentgenograms. (UK)

34492 BONE SCANNING WITH ^{87m}Sr USING TOTAL INFORMATION STORAGE AND CONTROLLED RETRIEVAL. Briggs, R. C.; Bartok, S. P.; Sorenson, J. A. (Univ. of Wisconsin, Madison). pp 128-31 of Radioactive Isotopes in the Localization of Tumors. McCready, V. R. (ed.). London; William Heinemann Medical Books Ltd. (1969).

From Symposium on Radioactive Isotopes in the Localization of Tumors, London, England. See CONF-670948.

The detection of areas of focal variation in heterolonic exchange of ^{87m}Sr for Ca may be more reliably demonstrated using total information storage and controlled retrieval. This paper describes the method and initial results using ^{87m}Sr bone scanning with a system of retrieval of data by means of closed circuit television. Provision was made for a low contrast photoscan of bone to be viewed by a vidicon camera and the resulting signal to be electronically modified in a controlled manner resulting in variable levels of background erase and contrast enhancement. In evaluation of the system, all variations in density across the film were detectable on the original photoscan and without data modification. The significance of the variations was more easily appreciated after the film was subjected to the extraction process, abnormalities frequently being noted only in retrospect. (UK)

34493 SOFT TISSUE SCANNING. Keeling, D. H. (Middlesex Hospital Medical School, London). pp 132-7 of Radioactive Isotopes in the Localization of Tumours. /McCready, V. R. (ed.). London; William Heinemann Medical Books Ltd. (1969).

From Symposium on Radioactive Isotopes in the Localization of Tumours, London, England. See CONF-670948.

The rapporteur briefly reviews five papers by authors from Roumania, Portugal, France, England and Belgium. The papers discussed chiefly liver scanning and possible means of improving prevailing dissatisfactory methods. Ways attempted included isotopic and instrumental modifications, closer analysis of abnormal scans and use of the blood isotope disappearance or the liver uptake curve. Isotopes discussed were mainly Tc-99m and colloidal Au-198. Instruments were scintillation counters, and modifications included thin septa collimators. (UK)

34494 LYMPH NODE SCANNING. Wolf, R. (Univ., Mainz). pp 138-42 of Radioactive Isotopes in the Localization of Tumours. /McCready, V. R. (ed.). London; William Heinemann Medical Books Ltd. (1969).

From Symposium on Radioactive Isotopes in the Localization of Tumours, London, England. See CONF-670948.

The papers reviewed by the rapporteur discuss lymph node scanning with colloidal radio gold. The methods described offer a visualization of lymph node chains in a region not to be investigated

by other means. Primary tumors were scanned with $^{197}HgCl_2$. Papers reviewed are as follows: (a) W. Buchwold, L. Diethelm, R. Wolf (Mainz, F.R.G.), Scintigraphic delineation of carcinoma of the breast and parasternal lymph nodes. (b) V. Samaras, G. Andritsakis, J. G. Garias, C. Sawas-Dimopolou, F. M. Dermentzoglou, G. K. Oikonomou (Athens, Greece), Scanning of malignant pelvic and inguinal lymph nodes. (c) J. D. Berrocal, J. M. Lopez, F. A. Bueno, A. C. Diez (Madrid, Spain), Study of parasternal lymph nodes by means of scanning and intramamonary injection of iodinated contrast media. (UK)

34495 INDIRECT LYMNOGRAPHY: A PHYSIOLOGICAL METHOD OF INVESTIGATING LYMPH NODES. Delaloye, B. (Univ. of Lausanne, Switzerland). pp 143-5 of Radioactive Isotopes in the Localization of Tumours. /McCready, V. R. (ed.). London; William Heinemann Medical Books Ltd. (1969).

From Symposium on Radioactive Isotopes in the Localization of Tumours, London, England. See CONF-670948.

The authors used colloidal Au-198 with mean particulate diameter of 50 Å, for isotopic lymnographies. The particles of gold deposited in the interstitial space through the pores of lymphatic capillaries and migrated to the lymph nodes, where in a normal subject the colloid was phagocytosed. Other compounds were found to leak to the venous system. The paper gives a very brief account of peripheral lymnography using a scanner, jugular and visceral lymnography, and lymphatic investigation using an Anger camera. The pictures obtained were more poorly defined than those obtained by radiography. A stationary detector was found to be preferable to a scan, particularly when quantitative measurements were possible. (UK)

34496 LIVER EXAMINATION IN CANCER PATIENTS WITH SCANNER AND GAMMA CAMERA USING ROSE RENGAL ^{131}I AS A TRACER. Jasinski, W. K.; Malinowska, J. (Curie Inst. of Oncology, Warsaw). pp 146-7 of Radioactive Isotopes in the Localization of Tumours. /McCready, V. R. (ed.). London; William Heinemann Medical Books Ltd. (1969).

From Symposium on Radioactive Isotopes in the Localization of Tumours, London, England. See CONF-670948.

This very brief note shows the following figures:- 1. A patient with carcinoid liver showing (a) good definition in a photoscan; (b) poor definition in a scintiphoto 2. Liver metastases from cancer of the uterus showing (a) good definition in a photoscan; (b) poor definition in an anterior scintiphoto; (c) good definition in a lateral scintiphoto. (UK)

34497 SPLEEN SCANNING AS AN AID TO TUMOR DIAGNOSTICS. Fischer, J.; Wolf, R. (Univ., Mainz). pp 148-50 of Radioactive Isotopes in the Localization of Tumours. /McCready, V. R. (ed.). London; William Heinemann Medical Books Ltd. (1969).

From Symposium on Radioactive Isotopes in the Localization of Tumours, London, England. See CONF-670948.

The results of scintigraphic investigations of 3065 patents indicated the inaccuracy of clinical methods in the detection of splenomegaly. Splenic scanning was performed using Tc-99m labelled, heat altered erythrocytes. All patients were subject to thorough clinical investigation. In 2646 cases a comparison between the results of clinical methods and scintigraphy was possible. In 1759 cases the spleen was definitely enlarged. Only 27.6% of the splenomegalies detected by scintigraphy were revealed by clinical investigation. (UK)

34498 RADIOISOTOPE TECHNIQUES FOR EVALUATION OF PULMONARY PATHOLOGY. Loken, M. K. (Univ. of Minnesota, Minneapolis). pp 151-4 of Radioactive Isotopes in the Localization of Tumours. /McCready, V. R. (ed.). London; William Heinemann Medical Books Ltd. (1969).

From Symposium on Radioactive Isotopes in the Localization of Tumours, London, England. See CONF-670948.

Scintiphotograms of the lungs using either a rectlinear scanner or a scintillation camera following the administration of macroaggregates of albumin labelled with ^{131}I or ^{99m}Tc provided a means of evaluation of regional pulmonary perfusion particularly where pulmonary emboli were suspected. The results showed the technique to be innocuous, reliable, and capable of being performed without discomfort to the patient. Studies using Xe-133 administered by injection or inhalation proved useful and probably will permit regional pulmonary function to be measured if equipment including scintillation camera, data storage devices and a computer, were available. (UK)

34499 RADIOISOTOPE SCANNING IN LUNG CANCER. Rana, S. A. K. (Cancer Inst., Louvain, Belgium). pp 155-60 of Radioactive Isotopes in the Localization of Tumours. /McCready, V. R. (ed.). London; William Heinemann Medical Books Ltd. (1969).

From Symposium on Radioactive Isotopes in the Localization of Tumours, London, England. See CONF-670948.

Lungs were scanned after intravenous administration of labeled macroaggregates of human serum albumin. Labeling was carried out with ^{131}I and ^{203}Hg neohydrin. The results revealed a disturbance of pulmonary arterial blood flow sometimes greater than expected from X-ray films of the chest. Observations showed the perturbation of pulmonary perfusion to be most marked in epidermoid type and moderate in oat cell and undifferentiated cancer; in the case of metastases, lymphosarcoma and Hodgkin's disease, the vascularization was less affected. (UK)

34500 BRAIN TUMOR DETECTION. Field, E. O. (Royal Marsden Hospital, Surrey, Eng.). pp 162-5 of Radioactive Isotopes in the Localization of Tumours. /McCready, V. R. (ed.). London; William Heinemann Medical Books Ltd. (1969).

From Symposium on Radioactive Isotopes in the Localization of Tumours, London, England. See CONF-670948.

The rapporteur has reviewed six papers devoted to brain scanning. Between them the authors recorded the results of nearly five thousand scans of which about one thousand were of patients with proven brain tumors. Four of the six papers described experience with radio-mercury neohydrin or with ^{99m}Tc-pertechnetate; one was concerned with the use of positron emitters and one used ^{131}I-iodide as a scanning agent. (UK)

34501 RIHSA MYELOGRAPHY: A METHOD IN THE DIAGNOSIS OF SPACE OCCUPYING INTRASPINAL LESIONS. Zeitler, E.; Wolf, R.; Dietz, H. (Univ., Mainz). pp 166-8 of Radioactive Isotopes in the Localization of Tumours. /McCready, V. R. (ed.). London; William Heinemann Medical Books Ltd. (1969).

From Symposium on Radioactive Isotopes in the Localization of Tumours, London, England. See CONF-670948.

More than 250 investigations of cerebro-spinal-fluid (CFS) spaces, using ^{131}I-RIHSA after suboccipital application showed that the optimum time for the delineation of the whole spinal cord lay between 8 and 24 hours after injection. Following lumbar application it was possible to delineate the lumbar portion of the spinal cord after 2 to 5 hours, the whole spinal cord could be seen only after 6 to 24 hours provided that no blocking of the passage existed. In cases of space occupying lesions, therefore, control scintigraphy was often necessary 24, 48, and even 72 hours after injection. (UK)

34502 COMPARISON OF TWO RADIOISOTROPIC TECHNIQUES IN BRAIN DISEASES: GAMMA ENCEPHALOGRAPHY (G.E.G.) WITH RIHSA AND CEREBRAL SCANNING WITH ^{99m}Tc PERTECHNETATE. Becquevort, P. A.; Merchie, G.; Mouchette, R. (Inst. of Medicine, Liege). pp 169-72 of Radioactive Isotopes in the Localization of Tumours. /McCready, V. R. (ed.). London; William Heinemann Medical Books Ltd. (1969).

From Symposium on Radioactive Isotopes in the Localization of Tumours, London, England. See CONF-670948.

The authors found that gamma-encephalograms and brain scans were generally in good agreement in the detection of neoplastic lesions, but, while ^{99m}Tc scintigrams were very helpful in localizing the lesions, they were generally disappointing in the information they provided as to the histology of the lesions. (UK)

34503 COMPARISON OF THE SCINTILLATION CAMERA WITH A RECTILINEAR SCANNER FOR EVALUATION OF BRAIN PATHOLOGY. Loken, M. K. (Univ. of Minnesota, Minneapolis). pp 173-6 of Radioactive Isotopes in the Localization of Tumours. /McCready, V. R. (ed.). London; William Heinemann Medical Books Ltd. (1969).

From Symposium on Radioactive Isotopes in the Localization of Tumours, London, England. See CONF-670948.

Results of phantom studies indicated that foci of Tc-99m or Hg-197 activity in pseudotumors were demonstrated equally well with a rectilinear scanner or scintillation camera. Likewise various forms of brain pathology were readily demonstrable with either unit and either radioisotope. Advantages of using Tc-99m were mainly its short life, which reduced patient hazards. Likewise the scintillation camera offered higher speeds and ease of positioning of the patient. (UK)

34504 RADIOPERTECHNETATE ^{99m}Tc IN THE DIAGNOSIS OF THYROID DISEASES. Kuba, J.; Kuchar, O.; Wiedermann, M. (Medical Faculty, Olomouc, Czech.). Cas. Lek. Cesk.; 107: 1388-91(8 Nov 1968). (In Czech).

Studies were carried out in 320 persons to measure the uptake of $^{99m}TcO_4^-$ in the thyroid gland 30 min after intravenous injection. In euthyroid subjects the values for accumulation of Tc were found to vary from 0.1 to 8.0%, in patients with toxic adenoma 2.3 to 10%, in hyperthyroidism from 4 to 44%, in hypothyrodism and in patients with inhibited accumulation (induced by administration of

iodine preparations) from 0 to 1%. The total number of false diagnoses between normal function and hyperthyroidism was 8%. In contrast to patients with hyperthyroidism, a correlation was found between the accumulation of radiopertechnetate and thyrotropin stimulation in patients with normal thyroid function. The possibilities of radiopertechnetate being used for diagnosis of thyroid diseases are discussed. (BBB)

34505 SAFETY IN LARGE ANIMAL RADIOGRAPHY. Ryan, G. D.; Deigel, H. J. (Cornell Univ., Ithaca, N. Y.). J. Amer. Vet. Med. Ass.; 155: 898-902(15 Sep 1969).

Hazards of radiation exposure and appropriate protective measures needed for veterinarians working with x rays are discussed. In veterinary medicine many practitioners apparently fail to employ adequate safety measures or to keep radiation exposure records, even though these are required by many state legal codes. Two primary considerations regarding radiation hazards in the practice of veterinary radiography are safety of persons assisting practitioners performing a radiographic examination and safety of practitioners operating an x ray machine. It appears that unnecessary radiation exposure occurs among assisting personnel, especially those employed by large animal practitioners. The practice of holding cassettes by hand or without the protection of leaded gloves or aprons exposes certain portions of bodies to primary radiation and the remainder to appreciable amounts of secondary radiation. By using a long-handled cassette holder, the person maintaining the position of the cassette can do so with the same ease and convenience as when holding the cassette by hand, and still remain safely distant from the primary and secondary x ray beams. A cassette holder designed by the authors to eliminate the need of having an individual hold the cassette by hand is described and illustrated. The standard operating procedure used at the New York State Veterinary College for radiographing large animals is explained. By adhering to this procedure, little or no x ray exposure to the radiographer or his assistants occurs. (BBB)

34506 RAPID EVALUATION OF THYROID NODULES USING ^{99m}Tc-PERTECHNETATE SCANNING. Sparagana, Mario; Little, Abby; Kaplan, Ervin (Veterans Administration Hospital, Hines, Ill. Loyola Univ. Stritch School of Medicine, Hines, Ill.) J. Nucl. Med.; 11: 224-5(May 1970).

The advantages of using ^{99m}Tc-pertechnetate for scanning for the evaluation of thyroid nodules are discussed. Patients with nodules that show uptake of radioactivity are given a stimulating dose of thyrotropin immediately following completion of the baseline scan and a second scan is performed 24 hr later followed by triiodothyronine suppression of thyroid function and a third scan after seven days. The entire evaluation is completed within eight days and requires only three visits. (C.H.)

34507 CORRELATION OF ANGIOGRAPHY AND ISOTOPE SCANNING IN ABDOMINAL DISEASES OF CHILDREN. Nebesar, R. A.; Tefft, M.; Filler, R. M. (Children's Hospital Medical Center, Boston, Harvard Medical School, Boston). Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 109: 323-40(Jun 1970).

The combination of isotope scanning using either ^{198}Au or ^{99}Tc-sulfur colloids for liver and ^{197}Hg-chlormerodrin for kidneys, and angiography is extremely valuable in the preoperative and postoperative evaluation of abdominal diseases, particularly hepatic disease, of children. This technique can accurately detect, show the extent of, and in many instances predict the nature of various hepatic abnormalities. Armed with this information, the pediatrician or surgeon is able to best decide whether surgery, irradiation, or medical management is indicated. (C.H.)

34508 ISOTOPE CISTERNOGRAPHY AND MYELOGRAPHY. Kvicala, V.; Minarikova, M. (Charles Univ., Prague). Cesk. Neurol.; 32: No. 1, 21-4(1969).

A method of scintigraphic visualization of the spinal canal and of the intracranial subarachnoid spaces using the intraarachnoid application of RIHSA is described. This diagnostic method is indicated in extramedullary lesions in the spinal canal, in primary and secondary intracranial arachnoiditis, and CSF fistulae. (Excerpta Med.)

34509 BRAIN SCANNING WITH ^{99m}Tc. Hornnes, N. Nord. Med.; 83: 326-30(1970). (In Norwegian).

The technical problems concerning brain scanning and choice of isotope are reviewed. Data on 459 patients scanned with ^{99m}Tc are submitted. It seems possible to diagnose tumors with the same accuracy as by neuroradiological examination (80 to 90%). This is in agreement with previous analyses. The promising results of brain scanning will no doubt reduce the requirement of special neuroradiological examinations. (auth) (Sweden)

34510 NON-UNIFORM BLOOD FLOW IN THE LEFT VENTRICULAR WALL OF DOGS MEASURED BY THE ^{133}Xe WASH-OUT TECHNIQUE. Andersson, Henning; Bagger, Henning; Goetzsche, Henning. (Univ. of Aarhus, Denmark). Acta Physiol. Scand.; 76: 376-82(1969).

Intra-myocardial injections of ^{133}Xe into the left ventricular wall revealed time-activity curves that indicate that blood flow in the subepicardial layers is 30 percent greater than in the subendocardial layers. A two-compartment model of the ventricular wall was, therefore, considered, and a good correlation was found between this model and the results of graphical and computer analyses of time-activity curves obtained by injections of ^{133}Xe into the left coronary artery. The flows of these two compartments and flows after superficial and deep intramyocardial injections were not identical. Thus the myocardial two-compartment model must be abandoned. A gradual decrease of flow from the subepicardial to the subendocardial surface is suggested. If this is true, then the wash-out curve after intra-coronary injection of ^{133}Xe is multi-exponential and thereby inaccessible to graphical analysis. (Sweden)

34511 COMPARISON OF DIAGNOSES OBTAINED WITH A SCANNER AND A GAMMA CAMERA AND THEIR CORRELATION WITH SOME LIVER FUNCTION TESTS IN LIVER SCINTIGRAPHY. Rissanen, P. M.; Patromaeki, L. K. (Univ. Central Hospital, Helsinki). Nucl.-Med.; 8: 366-74(31 Dec 1969).

The livers of 154 patients were studied with the aid of scintigraphy, done in succession with a scanner and a gamma camera, with the purpose of determining which of the two machines provided the more reliable results. The scanner alone gave 40% and the gamma camera alone 39% but both together 45% positive findings. There were consistent in 85% of the cases. A laparotomy or autopsy was performed on 23 patients within one month after scintigraphy. In two of these cases, a negative scintigram had been obtained despite metastases in the liver; no false positives were found. The correlation of alkaline phosphatase, 5-nucleotidase and GOT with the presence of liver metastases was found to be rather moderate. By using both machines together it is possible to arrive at slightly better results than by using either of them alone. (auth)

34512 STUDY OF CALCIUM METABOLISM WITH RADIOACTIVE ISOTOPES. THE SHORT-TIME TEST. Sack, Horst (Ruhr Univ., Essen). Nucl.-Med.; 8: 349-65(31 Dec 1969). (In German).

In 132 patients a short-time test of the kinetics of calcium and bone metabolism was developed and tested. This test provides results within 10 days, does not require normalized conditions of metabolism, and can be performed on ambulatory patients. The test uses two radioisotopes, oral ^{45}Ca and intravenous ^{47}Ca. The average whole-body radiation dose is about 2.2 rem. The tests extends over five consecutive days. It determines calcium absorption from the intestines, its distribution in the body, its accretion by the skeleton, its daily turnover, and its excretion. The normal values obtained are in agreement with those of several other authors, differences result from differences in methodology and from the assumption of different metabolic models. Significantly abnormal values were seen in patients with metabolic disorders such as hyperparathyroidism, hyperthyroidism, and osteomalacia. A diagnosis of primary osteoporosis was impossible but secondary forms accompanying hyperparathyroidism, gastrointestinal disorders, hypogonadism, and others were recognized. (auth)

34513 HYDRAULIC POSITIONING BED FOR RADIOISOTOPE IMAGING. Buchanan, Donald L. (Veterans Administration Hospital, West Haven, Conn.). J. Nucl. Med.; 11: 265-6(Jun 1970).

A uniquely versatile, hydraulically operated positioning bed was constructed for radioisotope imagining. Its use has resulted in greatly improved results with scanning and virtual elimination of patient discomfort. (auth)

34514 SCINTISCANNING IN THE ASSESSMENT OF REGIONAL PULMONARY FUNCTION. Taplin, George V. (Univ. of California, Los Angeles). pp 437-64 of Clinical Cardiopulmonary Physiology. /Gordon, Burgess L. (ed.). New York; Grune and Stratton, Inc. (1969).

The basic concepts, test agents, and technics for performing lung perfusion and radioaerosol inhalation scans are described. The significance of the lung images obtained is illustrated in animal experiments and from selected cases wherein scan data are correlated with radiographic findings, pulmonary function measurements, and laboratory data pertinent to the particular clinical situation. (C.H.)

34515 EFFECTIVENESS OF RADIATION THERAPY IN THE TREATMENT OF CARCINOMA OF THE ESOPHAGUS. A RETROSPECTIVE STUDY. Frazier, A. B.; Levitt, S. H.; DeGiorgi, L. S. (Medical Coll. of Virginia, Richmond). Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 108: 830-4(Apr 1970).

A review of 90 patients with carcinoma of the esophagus, treated at the Medical College of Virginia from January, 1961 through December, 1966, is presented. Factors affecting survival and symptomatic relief are discussed. The following points are stressed: obstruction requiring gastrostomy before or during radiation therapy is a contraindication to starting or continuing radiation therapy because of the poor survival and lack of symptomatic relief; the development of a tracheoesophageal fistula before or during the course of radiation therapy is a contraindication to further irradiation; a tumor dose of at least 5,000 to 6,000 rads or above should be our goal whenever there are no contraindications; palliative radiation therapy should be attempted to prevent esophageal obstruction when more radical therapy is not indicated; in this series the addition of radiation therapy to surgery whether pre- or postoperatively did not significantly alter the cure or survival statistics. (auth)

34516 DURATION OF LUNG CANCER DEVEOLOPMENT. Balmukhanov, S. B.; Dyusembaev, Z. E.; Turganbaev, A. T.; Zakhvatkina, I. A. Tr. Kaz. Nauch.-Issled. Inst. Onkol. Radiol.; 6: 108-11(1969). (In Russian).

Data on tumor growth in cases of lung cancer were based on a series of x-ray photographs and clinical data on 46 patients. Correlations were established between histological structure and life spans of lung cancer patients. For adenomas, the life span was 12.4; for squamous cell cancer, 7.4; and for undifferentiated cancer, 4.0. It was concluded that the nature of the disease is essentially chronic. (auth)

34517 SIGNIFICANCE OF GROWTH RATE DEFINITION IN DIFFERENTIAL DIAGNOSIS OF ROUND LESIONS OF THE LUNG. Dyusembaev, Z. E.; Turganbaev, A. T.; Abisatov, Kh. A. Tr. Kaz. Nauch.-Issled. Inst. Onkol. Radiol.; 6: 112-15(1969). (In Russian).

Diagnosis of globular lung tumors by means of x radiation is discussed and difficulties in techniques are pointed out. Data on differences in growth rate of globular neoplasms contribute to the problem of differentiating between benign and malignant tumors. (auth)

34518 MERITS OF COMBINED USE OF ANGIOGRAPHY AND SCINTIGRAPHY IN THYROID DIAGNOSIS. Schmidt, H.; Feine, U.; Hoffmann, K. (Univ., Tuebingen, Ger.). Fortschr. Geb. Roentgenstr. Nuklearmed.; 112: 469-78(Apr 1970). (In German).

In 45 patients, out of a total of 60 with goiters, scanning was carried out. In three no operation was performed, but in the others the operative and histological findings were available. It was found that the combined examination of thyroid storage and flow resulted in improved preoperative diagnosis. This was particularly valuable in the differential diagnosis between benign and malignant processes appearing as cold spots on the scan. (auth)

34519 USE OF RADIOISOTOPE NEPHROGRAPHY AS TEST FOR RECOVERY OF RENAL FUNCTION AFTER ACUTE RENAL FAILURE. Muschmov, D. (Institut fuer Arztliche Fortbildung, Sofia). Deut. Gesundheitsw.; 25: 443-6(13 Mar 1970). (In German).

Isotope-nephrographic examinations in 20 patients (15 women and 5 men) in the recovery phase following acute renal failure were reported. The examination was carried through 2 to 65 months following acute renal failure. A bilateral prolonged secretion-excretory phase manifesting the still incomplete tuberculosis-secretory function was detected in two patients in the second and fourth month following acute renal failure. A unilaterally disturbed secretory phase of the isotope nephrogram manifesting a residual functional injury of the one kidney was found in patients after 26 and 65 months following acute renal failure. (auth)

34520 SCANNING MALIGNANT NEOPLASMS WITH ^{67}Ga. Edwards, C. Lowell; Haynes, Raymond L. (Oak Ridge Associated Universities, Tenn.). J. Amer. Med. Ass.; 212: 1182-90(18 May 1970).

Gallium has an affinity for some human as well as animal neoplasms. Carrier-free gallium citrate labeled with ^{67}Ga administered intravenously is localized in a variety of malignant tumors that can then be detected on scintiscans. Nonosseous as well as skeletal lesions can be seen, including some that are not otherwise detectable. No untoward effects were observed in 41 patients studied. Scans were abnormal in 23 patients with a variety of malignant neoplasms; reticulum cell sarcoma, lymphoblastoma, and poorly differentiated adenocarcinoma gave the most consistent results. The 18 patients in whom scans were normal included three patients with plasma cell myeloma, four with lymphocytoma, and five with Hodgkin's disease involving small retroperitoneal nodes. Gallium localization is greatest in viable tumor, less in fibrotic or necrotic tumor, and diminished by irradiation and effective chemotherapy. The mechanism is unknown. (auth)

34521 PHARMACORADIOGRAPHY OF THE DUODENUM. Kajas, Seppo; Katila, Touko. Duodecim; 86: No. 2, 84-90(1970). (In Finnish).

Pharmacoradiography was applied in 20 cases of hypotonic duodenography, and in 35 postoperative cases, in which the duodenal stump was filled with barium. Chloropromazine was found to give similar results with propantheline. No side-effects appeared. Pharmacoradiography is advantageous both in hypotonic duodenography and in examination of the resected stomach. (auth) (UK)

34522 INCREASED EARLY RADIONUCLIDE ACTIVITY IN THE NASOPHARYNGEAL AREA IN PATIENTS WITH INTERNAL CAROTID ARTERY OBSTRUCTION: HOT NOSE. Mishkin, Fred S.; Dyken, Mark L. (Indiana Univ., Indianapolis). Radiology; 96: 77-80(Jul 1970).

In 17 of 900 radionuclide angiograms obtained with ^{99m}Tc pertechnetate, the nasal area contained marked activity prior to or coincidental with activity in major cerebral arteries. All but one showed anotomical or functional occlusion of one or both internal carotid arteries with a patent external carotid artery. In four patients, brain death proved at autopsy was present, while contrast angiography demonstrated obstruction of one internal carotid artery in 11 and obstruction of both carotid arteries in one. Only three with proved internal carotid artery obstruction failed to display a hot nose on angiography. Its presence suggests obstruction of an internal carotid artery with increased blood flow in the external carotid artery. (auth)

34523 ISOTOPE SCANNING IN INTRAARTERIAL INFUSION CHEMOTHERAPY. Erjavec, Marjan; Auersperg, Marija; Obrez, Ivo (Inst. of Oncology, Ljubljana, Yugoslavia). Invest. Radiol.; 5: 122-5(Mar-Apr 1970).

In patients with head and neck tumors treated by intraarterial chemotherapy, labeled particles were infused and injected through a catheter. Particles used were ^{131}I-labeled human serum albumin, ^{99m}Tc-labeled human serum albumin, and ^{113m}In-labeled iron hydroxide. Scintigraphic records obtained permitted the study of drug distribution under different hemodynamic conditions, tumor vascularization, and arteriovenous shunts. It was believed that radioisotope scanning gave better information about drug flow intraarterial chemotherapy than the use of contrast material and dye injection methods. (H.L.W.)

34524 STUDIES ON CLINICAL APPLICATION OF A SHORT-LIVED NUCLIDE /sup 113m/In AS RADIOISOTOPE IMAGING AGENT. Mishima, Tsutomu (Kanazawa Univ., Japan). Kanazawa Irigaku Sosho; No. 83, 101-26(Apr 1969). (In Japanese).

It is most desirable for radioisotope imaging of organs to use a large dose of a short-lived nuclide which increases the photon output while reducing the absorbed radiation dose to the patient. From this point of view, ^{113m}In is an ideal nuclide which is eluted from the ^{113}Sn-^{113m}In generator and decays with a half-life of 1.7 hours by emitting 390 keV gamma rays (no beta emission). The author has had experiences of four generators in our hand, the 10 mCi (NEN), two of the 25 mCi (UCC) and the 50 mCi generator (UCC) since Oct. 1966 and the clinical use of ^{113m}In was investigated as radioisotope imaging agents. It was first checked on whether ^{113m}In eluted from the generator with dilute HCl solution is suitable for clinical use. (1) More than 80% of ^{113m}In activity in each generator column could be eluted with pH 1.5 HCl. (2) The contamination of ^{113}Sn into ^{113m}In eluant was at maximum 5.2×10^{-3}% in the case of the 50 mCi generator used during four months. A dose of 10 mCi ^{113m}In at the time of elution would then contain only 0.52 μCi of tin. This amount is one-fifty eighth of the Maximum Permissible Concentration. (3) Any remarkable changes of the elution ratio of ^{113m}In and the contamination of ^{113}Sn were not found with each generator during several months. The shelf life of generator is very long. (4) The leakage of Zirconia adsorbing Tin on a column is very little, if it may exist, less than 4 μg per 1 ml of eluant. The toxicity of Zirconia is quite negligible on such amount because Zr compound has only a mild pharmacological action. The next step of the author's study was to prepare the ^{113m}In labeled compounds as follows: (1) The preparation of ^{113m}In Fe $(OH)_3$ particle was established for lung scanning. The particle size ranges from 20μ to 50μ in diameter enough to be microembolized at the capillaries of the lung and the number of the particles was calculated about 8×10^4 in 1 ml of the solution. The lung uptake was 83% on the average in rat. The radiation dose to the lung is only 0.75 rad per millicurie of ^{113m}In. (2) ^{113m}In sulfur colloid for liver and bone marrow scanning was devised. The liver uptake of this colloid was estimated to be 82% on the average

in rat 30 minutes after intravenous injection. This colloid is assumed to be captured by RES cell of the whole body. The absorbed radiation dose to the liver is 0.55 rad per millicurie. (3) The preparation of ^{113m}In Fe ascorbic acid was invented for blood-pool scanning. With pH 9.0 solution of this compound, ^{113m}In activity in blood was maintained as high as 81% at 120 minutes after intravenous injection in man, urinary excretion was only 0.9% of the injected dose during 2 hours. In addition to the low radiation dose, the high blood level and the lack of the activity in the bladder are advantages of this radiopharmaceutical for blood-pool scanning. (4) ^{113m}In Fe DTPA ascorbic acid was made for brain scanning. This chelate compound is excreted via renal glomerular filtration. The blood level was 37.4% at 30 minutes after intravenous injection and 18.7% at 120 minutes. The urine activity was 61.6% of the injected dose during 2 hours. The tumor to brain concentration ratio approached 34:1 in rat bearing Yoshida sarcoma. This compound was thus proved to be most suitable for brain scanning. The radiation dose per millicurie administered is 100 millirad to the kidney and 10 millirad to the whole body. (5) The preparations of (3) and (4) were used also for radioisotope and angiocardiography. Each preparation mentioned above was determined to be harmless to human use and the excellent images of organs were obtained with it. (NSA of Japan)

34525 EXPERIENCE WITH A REMOTE CONTROLLED DIAGNOSTIC X-RAY UNIT. Teske, H.-J.; Boehm, Ch.; Luebbert, H. (Ruhr-Univ., Essen). Radiologe; 10: No. 2, 66-73(1970). (In German).

Clinical experience with a remote controlled diagnostic x-ray unit is described. The unit consists of a fluoroscopic arrangement and a Bucky table with a focus film distance of 110 cm. The x-ray tube is arranged above the table while underneath is an image intensifier with connections to a television set and to a 70 mm film camera. The control panel is separated from the radiation room by a large lead glass window. Under normal conditions radiation exposure to medical personnel is zero. Special cases, where individuals must enter the room during radiation are discussed from a safety standpoint. The fluoroscopic arrangement is especially suitable for examination of esophagus, small intestine, colon, thorax, and renal excretion. It is moderately suitable for examination of the stomach; it is unsuitable for examination of joints requiring frequent relocations by the investigator. (H.B.G.)

34526 A SIMPLE AND SAFER ^{113m}In COLLOID PREPARATION FOR SCANNING THE LIVER. Sewatkar, A. B.; Patel, M. C.; Sharma, S. M.; Ganatra, R. D.; Quinn, J. L. (Bhabha Atomic Research Centre, Bombay. Tata Memorial Hospital, Bombay). Int. J. Appl. Radiat. Isotop.; 21: 36-8(Jan 1970).

For simplicity phosphate buffer was substituted for NaOH to neutralize the acid elute when preparing indium colloids. In addition mannitol was used as the stabilizing agent in the preparation. It was shown that either gelation or mannitol is necessary for stabilizing the colloidal suspension, and that the biological behavior of both types of preparation are identical but that mannitol is less likely to cause undue reactions in patients. (UK)

Radiotherapy

Refer also to abstracts 34108, 34117, 34128, 34132, 34134, 34148, 34333, 34334, 34342, 34350, 34351, 34353, 34354, 34363, 34364, 34566, 34574, 34581, 34609, 34645, 34687, 34690, 34692, 34697, 34706, 34719, 34722, 34726–34730, 34732, 34733, 34736–34743, and 34756.

34527 LATERALLY SCATTERED RADIATION USED IN SUPERFICIAL ROENTGEN THERAPY. Barbieri, P. L.; Mazzola, S.; Sabatini, F. (St. Eugenio Hospital, Rome. St. Gallicano Inst. of Dermatology, Rome). Acta Radiol., Ther., Phys., Biol.; 8: 480-6(Dec 1969).

Compton radiation laterally scattered from a block of paraffin in a conventional roentgen therapy applicator can be used in superficial roentgen therapy treatment. The low percentage depth dose in tissue is due to the Compton effect, the proximity of the radiation centers and absence of the intermediate glass walls that are present in conventional roentgen tubes. (auth)

34528 CARCINOMA OF THE TONSIL: SEQUENTIAL COMPARISON OF FOUR TREATMENT MODALITIES. Perez, Carlos A.; Mill, William B.; Ogura, Joseph H.; Powers, William E. (Washington Univ. School of Medicine, St. Louis). Radiology; 94: 649-59(Mar 1970).

Results of treatment in 134 cases of tonsillar carcinoma managed by four different modalities show that small lesions (Stages I and II) were controlled in a large proportion of patients by any method. Larger tumors were more effectively treated by radiation either alone or preoperatively. Complications of therapy occurred more often after preoperative irradiation and surgery, the most frequent being oro- or pharyngocutaneous fistula, carotid perforation, and osteomyelitis. If tolerated, doses in the range of 6,500 to 7,000 rads are recommended as the treatment of choice. All areas of potential spread must be included in the irradiated volume. (auth)

34529 USE OF ^{206}Bi IN THE TREATMENT OF CHILDHOOD LEUKEMIA. PRELIMINARY EXPERIMENTS. Mussa, G. C.; Martini-Marui, M.; Bacolla, D. (Univ., Turin). Minerva Pediat.; 21: 1374-9(21 Jul 1969). (In Italian).

Publications of Van der Werff on the use of ^{206}Bi in the therapy of several diseases, including chronic granulocytic leukemia and chronic lumphocytic leukemia, prompted the testing of the possibilities of the isotope in the field of childhood leukemias. Six cases are described, all involving patients who have proved resistant to the usual drugs, a child, age 14 months, died several days following the first administration of ^{206}Bi; no manifestations, either clinical or hematological, could be ascribed to the effects of the isotope. An identical outcome was registered in the case of a 12-year-old patient. A boy, age 4 to 5, responded favorably to four monthly injections of one mCi each. The first injection achieved an almost complete remission which lasted six months; then a sudden relapse, due to infection, led rapidly to death. Similar favorable and rapid response was observed in a 7-year-old child, now under treatment. In a girl, 7, suffering of acute lymphocytic leukemia, remission was followed by relapse which necessitated a new cycle of treatments; the patient is still alive. In a girl, 2, with acute lymphocytic leukemia, progressive improvement has been observed so far. No undesirable side effects occurred in any of the six cases. (59 references) (Leukemia Abstr.)

34530 THE VALUE OF RADIATION THERAPY FOR PITUITARY AND PARAPITUITARY TUMOURS. Kramer, S. (Jefferson Medical Center, Philadelphia). Can. Med. Ass. J.; 99: 1120-7(14 Dec 1968).

Radiotherapy was used either solely or in conjunction with operation for curative treatment in a series of patients with pituitary adenomas and in a series with craniopharyngiomas. The value of radiotherapy for pituitary adenomas has long been established. The histologic diagnosis in chromophobe adenomas is often extremely important. Biopsy may be obtained by a transphenoidal stereotaxic approach. Except where vision is threatened, radiotherapy without surgery remains the best treatment for eosinophil adenomas of the pituitary gland. Radiation therapy in the curative treatment of craniopharyngiomas is not yet well recognized. Considerably higher doses are required to treat craniopharyngioma than pituitary adenoma, but such doses have been found to be safe provided that supervoltage is used, the irradiated volume is kept small, and the previous operative intervention is limited to biopsy and emptying of the cyst if this is found to be present. In 26 patients with craniopharyngiomas, there was only one recurrence following radiotherapy in previously untreated cases and one patient in whom necrosis of the brain could be partially attributed to the radiotherapy. None of the long-term survivors have shown any added disability attributable to the radiotherapy. (auth) (Canada)

34531 GOALS AND LIMITATIONS OF TUMOR RADIOTHERAPY. Stender, H. St. (Medizinische Hochschule, Hanover). Med. Klin. (Munich); 63: 1146-51(19 Jul 1968). (In German).

Various effects of several types of irradiation used for tumor radiotherapy and methods for improvement of the effectiveness of irradiation treatment were discussed. These included increasing the tissue O_2 partial pressure in anoxic tumor areas, use of radiations whose biological effects are not decreased by the O_2 concentration or dependent on it, improved use of the varying sensitivity or regenerative capacity of healthy and malignant tissue by proper selection of irradiation fractionation techniques, activation of immunological factors, and destruction of tumor cells by combination of irradiation with cytostatic drugs or antimetabolites. The depth doses of 31-MeV x rays from the betatron, 14-MeV neutrons, 31-MeV electrons, ^{60}Co γ irradiation, 50-MeV π mesons, and 110-MeV protons were compared for tissue depths of up to 20 cm. Relations between the percent of anoxic tumor cells and 90% probability of cure with a single dose of 4400 to 9500 R of ^{60}Co irradiation, with a 5-cm diameter tumor containing 10^{10} to 10^{11} cells were tabulated. Effects of O_2 at 3 atm pressure on effectivity of x irradiation, survival of tumor cells that were 1% anoxic after irradiation with 6-MeV γ and neutron irradiation up to doses of 6000 Rem, and alteration of radiosensitivity of a benzpyrene tumor by implantation of a tumor autotransplant that had been x irradiated with a dose of 10,000 R were illustrated and discussed. References cited, 57. (BBB)

34532 VALUE OF RADIATION THERAPY IN THE TREATMENT OF CANCER OF THE ENDOMETRIUM. Burr, R. C.; Robertson, E. M. (Ontario Cancer Foundation, Kingston). Can. Med. Ass. J.; 99: 206-10(3 Aug 1968).

A study of 246 cases of cancer of the endometrium treated by surgery alone, surgery combined with radiation, and radiation alone is presented. Assessment was made of the morbidity resulting from treatment and of the rate of tumor recurrence in the vault of the vagina. The cases were classified retrospectively according to the International Classification of Endometrial Carcinoma. The survival data were not statistically significant because of the small numbers of patients available for study; however, there is clinical evidence of a trend towards an increased five-year survival rate for those patients treated by a combination of preoperative radiation and surgery. In this group, there was a decrease in the rate of recurrence in the vaginal vault following the use of preoperative intrauterine radiation. When radium was also placed against the cervix, there was a further reduction in the recurrence rate. While radiation carries with it the possibility of increased morbidity, it has not shortened the life of these patients. Care must be taken not to exceed tissue tolerance. (auth) (Canada)

34533 MEDULLOBLASTOMA IN CHILDHOOD: RADIATION THERAPY. Jenkin, R. D. T. (Princess Margaret Hospital, Toronto). Can. Med. Ass. J.; 100: 51-3(11 Jan 1969).

During the period 1940 to 1965, 47 children were seen following operation for posterior fossa medulloblastoma or cerebellar sarcoma. Their response to irradiation is reviewed. Before 1952, 16 received postoperative irradiation to less than the whole central nervous system. None survived four years after the operation. Since 1952, 30 children have completed postoperative irradiation to the whole of the CNS (approximately 3200 Rads over four to five weeks). Eight of 15 patients survive at five years and three of six patients at 10 years. The site of first recurrence after whole CNS irradiation was the posterior fossa in 15 out of 18 patients. Provisional evidence is presented that an additional 1000 to 1500 Rads in 7 to 10 days to the posterior fossa may reduce this recurrence rate. (auth) (Canada)

34534 HIGH ENERGY ELECTRON BEAM THERAPY FOR HEAD AND NECK CANCER. Brizel, H. E.; Scott, R. M.; Davis, T.; Jacobson, A. (Univ. of Louisville, Ky.). J. Can. Ass. Radiol.; 14: 112-6(Sep 1968).

The main advantage of electron beam radiotherapy is the sparing of normal tissue relative to the tumor because of the inherent rapid attenuation of dosage of an electron beam, depending on its energy. Treatment planning and clinical dosimetry are relatively simple and personal experience indicates that the RBE of electrons corresponds to supervoltage photon irradiation and that skin reactions do not significantly preclude radical therapy to lesions in the oral cavity, oropharynx, or cervical lymph nodes. Statistical evaluation of survival is not yet possible but immediate tumor response parallels that from photon irradiation and patient tolerance is definitely improved. (auth) (Canada)

34535 POSTOPERATIVE TREATMENT OF CARCINOMA OF THE BREAST WITH TELECESIUM. Bluhm, Henry W.; Hummon, Irvin F.; Lutterbeck, Eugene F. (Cook County Graduate School of Medicine, Chicago). Int. Surg.; 52: 290-300(Oct 1969).

Primary among the attributes of telecesium-137 for postoperative treatment of carcinoma of the breast is its skin-sparing effect with an electron buildup of 1.4 mm below the skin, which makes it a good method of radiation treatment, particularly of breast cancer. The areas of the breast to be treated are not extremely deep and an adequate tumor dose may be attained with the telecesium unit. This makes it possible to treat the entire breast with no untoward effects to the skin after a high dosage of 5,000 to 6,000 Rads with telecesium-137, largely due to its skin-sparing effect. This was demonstrated in the satisfactory results in a series of 126 patients with carcinoma of the breast treated postoperatively with cesium-137 teletherapy. The long half-life of the cesium teletherapy unit of 27 years obviates frequent source replacement, making it a valuable asset to small hospitals, radiation centers of private institutions and the private radiologist. (auth)

34536 RADIOTHERAPY IN CHILDHOOD. Schumann, Eberhard (Medizinische Akademie, Erfurt, Ger.). Z. Aerztl. Fortbild.; 62: 521-8(15 May 1968). (In German).

The risks and particular conditions for irradiation treatment of children, and the results of irradiation treatments were reviewed. Factors that affected treatment were the large size of tumor relative to body size of children; requirements for protection of healthy adjacent tissue; advantages of ultrahard electrons, x rays, and γ radiations in tumor treatment; increased mitotic activity in children; and marked radiosensitivity of bone epiphyses, gonads, lens, thyroid gland, and developing mammae. Indications for and results of irradiation treatment reviewed included tumors, congenital malformations, meningitis, and nephritis. In acute leukemia, irradiation treatment was most successful for lymph node enlargements and painful bone alterations. For small surface tumors in children, various sealed irradiation sources had been used successfully. The tumors most successfully treated with irradiation included lymphosarcoma, reticulosarcomas, lymphogranulomatoses, Wilms tumors, thymus hyperplasia, keloids, and various types of furuncles, abscesses, nonspecific lymphadenites, and interstitial infantile pneumonia. (BBB)

34537 CLINICO-STATISTICAL SURVEY ON RADIOCOBALT TELETHERAPY OF 139 BLADDER NEOPLASMS. Milani, F.; Musumeci, R.; Volterrani, F. (Univ., Milan). Quad. Radiol.; 33: 467-83(Sep-Oct 1968). (In Italian).

Vesical neoplasms treated with telecobaltotherapy at the National Institute for Study and Treatment of Tumors, of Milan, from June 1958 to June 1966 were considered. Out of 139 cases, 61 had undergone previous treatment; 11 had undergone an explorative laparatomy in which the extension of the disease induced surgeons to renounce to the intervention. The other 78 patients had previously received various surgical treatments, and the radiological therapy has been carried out in 20 cases owing to relapse that was no longer operable, and in 50 cases because the surgical extirpation seemed not to be radical. The data referring to the anatomo-clinical-radiological aspects of these tumors are tabulated with indications of the performed treatment and the administered doses. The grouping according to the TNM scheme allows to point out that the least infiltrant forms (T_1 and T_2) show percentages of survival that appear to be clearly higher both after three and after five years from the beginning of the treatment: these are, in fact, the cases in which irradiation had been performed in a more convenient way by administering effective doses at a rate of a least 5000 Rad in 40 to 50 days. Half of the patients died within 18 months from the beginning of the treatment. Of the cases, 34.6% were living at three years and 27.8% at 5 years. The average survival appeared to be 26.6 months. (auth)

34538 RADIOGRAPHY AND TNM CLASSIFICATION OF CANCER OF THE LARYNX. A STUDY BASED ON 1447 CASES SEEN AT THE RADIOTHERAPY CLINIC OF HELSINKI DURING 1936–1961. Taskinen, J. Pentti (Univ. of Helsinki). Acta Radiol., Suppl.; No. 278, 121p(1969).

Thesis.

The TNM classification was performed retrospectively on the basis of case report data. The clinical status at the start of therapy showed an improvement during the years under examination. The proportion of T1 cases increased from 8.3% in the 1930s to 29% in the early 1960s, and that of T4 cases decreased correspondingly from 18 to 6.8%. The treatment was primary radiotherapy in 933 cases (64%), surgery plus postoperative radiotherapy in 350 cases (24%), surgery alone in 59 cases (4.1%), other measures in 73 cases (5.0%). The primary and postoperative radiotherapy consisted of roentgen therapy (chiefly 190 kV, 12 mA, 1.0 mmCu, H.V.L. 1.5 mmCu). The aim was to administer a tumor dosage of 5,000 R in 24 to 26 daily fractions in 28 to 30 days. The reaction of the skin and normal tissues of the larynx was followed during therapy. Tumor response to primary radiotherapy was also observed. The radiotherapy reactions were compared with the patient's hemoglobin values prior to therapy. The reaction was statistically significantly more intense in the presence of higher Hb values. This observation was made in the different tumor dose and T groups separately. It was obvious that the oxygen concentration of the tissues improved when the Hb level was higher and this caused a more intense radiation response. Primary radiotherapy was found to be the best intervention as regards the functional result, the frequency of laryngectomy was only 5.3%, while that of surgery alone was 54 and of surgery plus radiotherapy 58%. At the last follow-up examination 50% of the patients were free from cancer after radiotherapy and 39% had normal laryngeal function. The corresponding percentages after surgery plus postoperative radiotherapy were 64 and 24% and after surgery alone 35 and 16%. Primary and especially postoperative radiotherapy reduced highly significantly the frequency of metastases and recurrences. The 3-year result was decisive for the final prognosis; only rare metastases (11%) or recurrences (15%) were encountered after that time and the mortality rate of the patients concurs with the life expectancy of a 60-year-old man, the mean age of the material. The crude 10-year survival rate was 176/1 020 (25%) and the 15-year rate 81/659 (12%). The TNM classification proved a very good way of presenting the therapeutic results. It permitted the formation of uniform groups. (auth) (Sweden)

34539 METHOD FOR POSTOPERATIVE PENDULAR IRRADIATION OF MAMMARY CARCINOMAS BY USING DIFFERENT ELECTRON ENERGIES. Schmidt-Hermes, Heinz Josef (Univ., Homburg, Ger.). Strahlentherapie; 139: 139-42(Feb 1970). (In German).

Depth dose measurements are performed on a plexiglass-water phantom exposed to a 42 MeV betatron beam. Especially empha-

sized is the irradiation of parasternal and mediastinal lymph nodes as an adjuvant to total mastectomy for mammary carcinoma. Dependency of the dose distribution on energy and pendular motion are discussed. (H.B.G.)

34540 NEW TECHNICAL APPLICATION OF TOTAL PELVIC TELECOBALT IRRADIATION. Ozarda, A. T.; Rembert, F. M. (Univ. of Texas, Galveston). Strahlentherapie; 139: 159-61 (Feb 1970).

A new pelvic portal utilizing a lead block with an oval aperture was described for the treatment of pelvic malignancies with particular reference to carcinoma of the cervix. A comparison was made with square and diamond portals and the advantages of the oval portal were described. (auth)

34541 RADIOBIOLOGY AND RADIOTHERAPY. Tubiana, M.; Wambersie, A. (Institut Gustave-Roussy, Villejuif, France). pp 255-320 of Actions Chimiques et Biologiques des Radiations. /Haissinsky, M. (ed.). Paris; Masson et Cie, Editeurs (1968). (In French).

Effects of radiation on mammalian cells are reviewed with emphasis on the cell cycle, the cell survival curve, radioinduced delay in cell division, and cellular differentiation. A review of studies on factors influencing cell radiosensitivity includes cell characteristics, oxygen, chemical radiosensitizers, chemical radioprotective agents, and LET. A review of the phenomena of cellular repair following injury by fractionated doses of radiation is presented. Effects of radiation on tissues are reviewed with emphasis on development of tissue models and their reaction to single radiation doses, effects of fractionated radiation doses, and effects of chronic irradiation. A review of problems posed by radiotherapy of tumors includes discussions of tumor growth and kinetics of cellular proliferation, anoxic cells within the tumor, dose fractionation, validity of tissue models in radiotherapy, and radiosensitivity and radiotherapy correlations. (210 references) (H.L.W.)

34542 TREATMENT OF THE AUTONOMOUS HOT NODULE OF THE THYROID WITH ^{131}I. Cardenas, Rene; Oliva, Juan (Oncological and Radiobiological Inst., Havana). Nucl.-Med.; 8: 339-48(31 Dec 1969).

Thirty-four women with single autonomous hot nodules of the thyroid were treated with ^{131}I. There was a variable degree of thyrotoxicosis in twenty-six cases while in three others only local cervical discomfort was noticed. The total amount administered varied between 2 and 80 mCi of ^{131}I and the radiation dose to the thyroid from 2 to 450 krads. The nodule and symptoms disappeared in fourteen of the patients, while in the other fourteen the lesion decreased in size and the clinical manifestations improved. Only in six patients was the resulted unsatisfactory, without change in the size of the nodule. Results are analyzed on the basis of the quantity of radioiodine administered. Modifications of the scintigram before and after treatment are discussed, observing that the cooling of the nodule and the reappearance of the surrounding gland are signs of good prognosis. A case is described in which the therapy failed and a thyroid carcinoma was found after surgical resection. Two cases of the series in which there were slight transitory manifestations of post-therapeutic hypothyroidism are also reported. (auth)

34543 PATIENT DOSIMETRY IN THE ELECTRON TREATMENT OF LARGE SUPERFICIAL LESIONS. Page, Vera; Gardner, Angela; Karzmark, C. J. (Stanford Univ. School of Medicine, Calif.). Radiology; 94: 635-41(Mar 1970).

Measurements were made on circular and body-shaped phantoms in an effort to find an optimal technique for the treatment of superficial skin lesions, such as mycosis fungoids, with electrons, one in which adequate uniformity of dose and penetration would be coupled with an acceptably accurate patient dosimetry calculation suitable for routine use. As a result of this study, a modification of the Stanford technique was adopted. (auth)

34544 RADIATION THERAPY AND AUTOIMMUNE DISEASE. Hazel, J.; Bouchard, J. (Royal Victoria Hospital, Montreal). J. Can. Ass. Radiol.; 14: 117-20(Sep 1968).

The enlarging field of autoimmune disease is briefly reviewed. Some of the common histopathologic features are mentioned. It became apparent that a number of cases of disease in this category had been treated in the past by radiation therapy on a more or less empiric basis, before their autoimmune character was recognized. Several cases of myasthenia gravis without thymoma, Mikulicz's disease, one case of Hashimoto's disease, and autoimmune hemolytic disease are reviewed from the point of view of radiation therapy used in their management and the results of treatment. Seventy recent cases of kidney transplants from cadavers are reviewed and the rationale for local radiation therapy to the graft is presented. Finally, an attempt is made to relate the use of radiation therapy to the autoimmune diseases in their present state and to organ transplantation in the future. It is concluded that radiation therapy is beneficial in a number of cases of localized autoimmune processes where a specific organ is the site both of the antigen production and the autoimmune activity. In organ transplantation, localized radiation to the graft appears useful as a method of delaying or reversing rejection attempts. Radiation of an extracorporeal blood shunt serves a similar purpose. As an investigative tool, radiation is proving useful in helping to study the immune response itself. (auth) (Canada)

34545 EFFECT OF PRETREATMENT WITH CARBIMAZOLE IN PATIENTS WITH THYROTOXICOSIS SUBSEQUENTLY TREATED WITH RADIOACTIVE IODINE. Goolden, A. W. G.; Fraser, T. Russell (Hammersmith Hospital, London). Brit. Med. J.; 3: 443-4(23 Aug 1969).

Effects of preliminary treatment with carbimazole in a series of 181 patients with thyrotoxicosis selected for treatment with ^{131}I were discussed. Pretreatment with methylthiouracil and propylthiouracil was reported to make the thyroid gland relatively radioresistant. All patients were treated at the dose level of 150 μCi/g except for those estimated to have glands of 70 g or more, that were treated at a dose level of 300 μCi/g. The size of the gland was estimated by palpation. The interval between stopping treatment with carbimazole and giving the therapeutic dose was from 3 to 5 days. A final assessment of the response to a single dose of ^{131}I made 1 yr after treatment showed that out of 83 patients treated with carbimazole 17% were hypothyroid, while out of 98 patients not treated with carbimazole 13% were hypothyroid. Pretreatment with methylthiouracil and propylthiouracil in thyrotoxicosis modified the response to ^{131}I therapy. Thiourea and related compounds such as thiouracil had a protective effect on tissues subject to irradiation. Unlike other compounds that contain a sulfhydryl group and also have a radioprotective action, carbimazole which does not contain a sulfhydryl group did not modify the hypothyroid response of thyrotoxic patients to treatment with ^{131}I. (BBB)

34546 LARGE DIMENSIONAL MULTIFOCUS RADIATION SOURCE IN SUBCUTANEOUS SIEVE THERAPY. Kiami, P.; Ruotsalainen, P. (Univ. of Turku, Finland). Acta Radiol., Ther., Phys., Biol.; 8: 471-9(Dec 1969).

Phantom experiments suggested that the best object for sieve therapy is the subcutaneous tumor that can be radically irradiated by using a large dimensional radiation source and a short source-skin distance. The theory is discussed in detail. (auth)

34547 PITUITARY DESTRUCTION FOR DIABETIC RETINOPATHY. Lancet; 2: 415-16(23 Aug 1969).

The advantages of radiohypophysectomy by implantation of ^{90}Y seeds were discussed and compared with other methods of pituitary destruction. Radiohypophysectomy caused less disturbance to the patient than surgical methods and was useful in those unfit for a major operation. Though there was a risk of cerebrospinal rhinorrhoea and meningitis, it was low in skilled hands. External irradiation of the pituitary by supervoltage x rays or heavy particles has the disadvantage that the rate of pituitary destruction is both gradual and variable. Only a small minority of patients with diabetic retinopathy is suitable for radiohypophysectomy. Although microaneurysms and retinal hemorrhages may improve after treatment, they are not in themselves a serious threat to vision and alone would not justify radiohypophysectomy by ^{90}Y. Once fibrous proliferation has appeared, its course is not affected by radiohypophysectomy. In a small series of patients treated by ^{90}Y implantation, there was improvement in retinal hemorrhages in 50%, in new vessel formation in 30%, and in venous dilatation in 20%. In a proportion of patients radiohypophysectomy gives useful improvement, but in some patients retinopathy continued to progress in spite of treatment. Improvement on the earlier figures was probably due to better selection and treatment of patients with less severe disease. A review of 11 series and 708 patients treated by pituitary ablation indicated that retinopathy could be halted in many cases which meet the criteria, but there was no clear evidence that pituitary destruction had a beneficial effect on other diabetic complications, such as renal disease and neuropathy. The exact mechanisms of improvement in diabetic retinopathy after pituitary destruction was discussed, but it was not established. (BBB)

34548 QUANTITATIVE STUDY OF VASCULAR RESPONSE IN IRRADIATED WOUNDS. Gotto, C. A.; ; Mayo, J.; Cabrini, R. L.; Itoiz, M. E.; Carranza, F. A. (Univ. of Sao Paulo, Brazil. Univ. of Buenos Aires). Surg. Gynecol. Obstet.; 130: 875-8 (May 1970).

A quantitative study of vascularization of irradiated wounds was made in rats. Irradiation with 6,000 rads produced an initial depression of vascular development and a subsequent recovery

of blood vessel response. The timing of these events depended on the healing stage in which the wounds were irradiated. Seventy-five days after injury, all control and irradiated wounds exhibited the same pattern and degree of vascularization. (auth)

34549 REMOVAL OF THE THYROID GLAND IN RATS BY THYROIDECTOMY AND IODINE ISOTOPE ADMINISTRATION. Rudolph, H.; Schiemer, H.-G.; zum Winkel, K.; Schimmelpfennig, K. (Univ., Heidelberg). Fortschr. Geb. Roentgenstr. Nuklearmed.; 110: 730-4(1969). (In German).

Thirteen male rats of the Wistar-breed were given a 0.34 μCi ^{131}NaI dose/g body weight, or multiples thereof, intraperitoneally at four-week intervals beginning four weeks after thyroidectomy. A second group of 18 animals received the same treatment without thyroidectomy. The remaining thyroid tissue was examined histologically and radiologically. It was found that only the thyroidectomized animals that received a single dose of 1.36 μCi ^{131}I/g body weight showed a complete elimination of all thyroid tissue. (auth)

34550 EFFECT OF PODOPHYLLIC ACID ETHYL HYDRAZIDE COMBINED WITH X RAYS ON A SOLID ISOLOGOUS TUMOR IN C3H MICE. Donner, M.; Oth, D.; Burg, C. (Faculte de Medicine, Nancy). Rev. Med. Liege; 23: Suppl. No. 1, 161-5 (Oct 1968). (In French).

The effects of combined treatment with x irradiation and podophyllic acid ethylhydrazide (SPI) on a rhabdomyosarcoma transplanted into mice were studied. The irradiation used consisted of a single dose of 1500 R of x ray administered at a rate of 75 R/min. The SPI dose used was 147 mg/kg body wt, given in a single dose. This dose was the LD_{50} 30-day dose for SPI. The SPI was given from 30 min to 24½ hr before the tumor transplantation or up to 24 hr before the irradiation. The SPI treatment given alone had no effect on tumor growth, and irradiation treatment by itself had a slight effect, though it was not statistically significant. When SPI was given at intervals up to 6 hr before irradiation, tumor growth was markedly diminished. However, when SPI was given from 12 to 24 hr before irradiation there was no effect on tumor growth. From the results observed it was not possible to conclude whether the effects of the combined treatmept were due to radiosensitization, radiopotentiation, or a simple additive effect of the two treatments. (BBB)

34551 APPRAISAL OF ESOPHAGUS TUMOR RADIOSENSITIVITY BY ITS REGRESSION SPEED. Balmukhanov, S. B.; Valieva, R. K.; Turganbaev, A. T. (Inst. of Oncology and Radiology, Alma-Ata, USSR). Tr. Kaz. Nauch.-Issled. Inst. Onkol. Radiol.; 6: 95-9(1969). (In Russian).

Radioinduced regression of oesophageal cancer was studied in 200 patients. Roentgenological data were used for measuring the volume of the tumors. The regression rate of the tumors was used as an indicator of radiosensitivity. The smallest fractionated doses showed the slowest regression rate. (auth)

34552 RADIOSENSITIVITY OF MALIGNANT MELANOMA. Gol'bert, Z. V.; Larioshchenko, T. G.; Papliyan, N. P. (Oncology Inst., Moscow). Tr. Kaz. Nauch.-Issled. Inst. Onkol. Radiol.; 6: 100-4(1969). (In Russian).

Clinical and morphological studies on 135 cases of primary melanomas demonstrated the radiosensitivity of the tumors. Results of studies on 56 cases of lymph node melanomas indicated that radiation could be used for palliation or control of tumors. It was observed that the radiosensitivity of the melanoma depends on the radiation dose, morphological type, and size of the tumor. The interval between irradiation and surgery influenced the degree of radiation changes. It was found that the fusiform cell malignant melanomas were more radioresistant than epithelioid cell melanomas and that the metastases were more radioresistant than primary tumors. The data obtained are of importance for combined radiation and surgical methods of treating primary and metastatic melanomas. (auth)

34553 COMBINED USE OF COLCHAMINE AND GAMMA RADIATION FOR TREATMENT OF PATIENTS WITH CANCER OF THE ESOPHAGUS. Tsoi, A. I.; Dement'eva, N. I.; Balieva, R. K.; Abdrakhmanov, Zh. N. (Inst. of Oncology and Radiology, Alma-Ata, USSR). Tr. Kaz. Nauch.-Issled. Inst. Onkol. Radiol.; 6: 177-80(1969). (In Russian).

Forty-three patients with cancer of the esophagus were treated with γ radiation. Results were compared with data from the same number of patients exposed to other forms of radiotherapy. The response of patients treated with colchamine and radiation on alternate days did not differ from the response of those treated with γ radiation alone. When colchamine was administered before irradiation, the treatment was more effective. (auth)

34554 COMPARATIVE STUDY OF THREE FRACTIONATION METHODS IN COBALT THERAPY OF ADVANCED FORMS OF ESOPHAGUS CANCER. Smagulov, A. S.; Balmukhanov, S. B.; Zholkiver, K. I.; Dzhetteev, K. Z.; Abdrakhmanov, Zh. N.; Musabaeva, L. I.; Turganbaev, A. T. (Inst. of Oncology and Radiology, Alma-Ata, USSR). Tr. Kaz. Nauch.-Issled. Inst. Onkol. Radiol.; 6: 256-60(1969). (In Russian).

Immediate and late results of ^{60}Co teletherapy of 308 patients with advanced cancer of the esophagus were analyzed. One hundred patients were given large dose fractions (600 to 800 rad twice weekly). Ninety-five patients were given doses of 400 rad three times weekly, and 113 patients were given 200 rad six times weekly. The overall doses were 3500 to 4500 rad in the first group, 5000 to 7000 rad in the second, and 6000 to 8000 rad in the third. Good results were achieved in 91% of cases in the first group and in 63 to 64% in the other two. The difference is statistically significant. Late results were also better in the first group. The average survival was 10.3 months for the first group, 6.8 months for the second, and 6.4 for the third. There was no difference in late results between the three groups. It was concluded that large fractions had a more pronounced palliative effects and somewhat prolonged the life span. (auth)

34555 COMPARATIVE RADIOLOGICAL STUDY OF RADIATION THERAPY OF LUNG CANCER BY THE METHODS OF BIG AND SMALL FRACTIONS. Dyusembaev, Z. E.; Balmukhanov, S. B.; Dzhetteev, K. Z. (Inst. of Oncology and Radiology, Alma-Ata, USSR). Tr. Kaz. Nauch.-Issled. Inst. Onkol. Radiol.; 6: 261-5(1969). (In Russian).

Large and small dose fractionation methods were used for radiotherapy of globular lung cancer. It was noted that the large fractions were more effective than the small ones. It was observed that the radiosensitivity of undifferentiated cancer was higher than that of squamous cell lung cancer. It was concluded that the disappearance of the tumor shade on the x-ray photograph did not mean that the patient was completely cured. (auth)

34556 EWING'S SARCOMA. A TRIAL OF ADJUVANT TOTAL-BODY IRRADIATION. Jenkin, R. D. T.; Rider, W. D.; Sonley, M. J. (Princess Margaret Hospital, Toronto, Hospital for Sick Children, Toronto). Radiology; 96: 151-5(Jul 1970).

Sixteen patients with Ewing's sarcoma treated by local γ irradiation and 10 patients treated by similar local irradiation plus 300 rads total-body γ irradiation are compared. Survival in the latter group was moderately improved, justifying further evaluation of this form of systemic therapy in Ewing's sarcoma. (auth)

34557 RESPONSE OF SUPERIOR SULCUS TUMORS TO RADIATION THERAPY. Bretz, Giselle; Lott, Stewart; El-Mahdi, Anas; Hazra, Tapan (Johns Hopkins Univ., Baltimore). Radiology; 96: 145-50(Jul 1970).

In 15 cases of superior sulcus carcinoma treated by γ irradiation and followed for one year, a 9.7-month mean survival time was noted; for those survivals over six months, a 14.9-month mean was recorded. In two patients surgical removal of the primary followed irradiation; tumor necrosis resulted from therapy, with no evidence of clearly viable tumor cells remaining. Study of palliative dose response as a function of time indicated optimum dose-time relationship to be about 3,500 rads in a two- or three-week period. Irradiation alone is the favored treatment; preoperative irradiation is reserved for early disease. (auth)

34558 EFFECTIVE APPLICATION OF ELECTRON RADIATION AND ^{60}Co GAMMA RADIATION FOR THERAPY OF MALIGNANCIES. Ott, Alois (Sonderabteilung fuer Strahlentherapie im Krankenhaus der Stadt, Vienna). Roentgenpraxis; 22: 283-303(Dec 1969). (In German).

Electrontherapy is the method of choice for tumors of the skin and for malignancies that are located not more than 10 cm below the skin. Deeper lying tissues are not affected, bone is relatively insensitive to electron radiation, and the exposed tissue volume is more restricted than in the case of gamma radiation. General metabolic effects, as assessed by cholesterol, calcium, potassium, and magnesium levels in the blood, are much less following electron radiation as compared to gamma radiation. For skin cancer, electrontherapy will become increasingly the ideal treatment. Several case histories are given. Furthermore, electrontherapy leads to excellent results in metastases of cervical and of guinal nodes. Favorable results with electrons were obtained also in carcinomas of tonsils, parotids, lungs, and bladder. Cases in which teletherapy is the treatment of choice are briefly outlined, especially with respect to carcinomas of larynx, epipharynx, esophagus, lungs in obese persons, and the uterus following radium treatment. (H.B.G.)

34559 PRELIMINARY EVALUATION OF ^{222}Rn GAMMA RADIATION THERAPY IN HORSES. Dixon, R. T. (Univ. of Sydney). Aust. Vet. J.; 45: 389-94(Sep 1969).

The use is discussed of Rn-222 for the treatment in horses of chronic granulomatous lesions, selected neoplasms and aseptic inflammatory conditions of bones, joints and tendons. Reports

were obtained on 38 treatments in 29 horses. Use of Rn-222 therapy seems indicated in cases of carpitis without fracture or arthritis, splints, sesamoiditis, navicular osteritis and hairline fractures of the navicular bone. Adequate subsequent rest is essential when radiation is used as a method of controlling osteitis and periostitis. Use of Rn-222 therapy for suspensory ligament sprains does not seem indicated. In the treatment of chronic granulomatous wounds, covering of the area by epithelium can be hastened by resecting the granulation level with the skin, either before or after irradiation. The results of irradiating melanomas and a squamous cell carcinoma indicate that Rn-222 should be considered as an acceptable alternative to euthanasia in inoperable cases of these tumor types. (Australia)

34560 CAPABILITIES AND LIMITATIONS OF MODERN RADIOTHERAPY. Frommhold, W. (Univ., Tuebingen, Ger.). Therapiewoche; 19: 2439-45(3 Dec 1969). (In German).

Modern radiotherapy is discussed especially with respect to electron and cobalt-60 gamma radiation. The many advantages, as compared to older conventional radiation techniques, are outlined. Both local and general complications are quite rare. Electron therapy and teletherapy is not advisable, however, when not at least palliation can be expected, when multiple bone metastases exist, when the liver is involved, or when the skin is severely damaged, as is frequently the case in breast amputation. (H.B.G.)

34561 EUSTACHIAN TUBE IRRADIATION WITH ^{90}Sr. Siedentop, Karl H. (Univ. of Illinois, Chicago). Arch. Otolaryngol.; 92: 71-5(Jul 1970).

Strontium-90 β intratubal treatment of eustachian tubes in ears with chronic otitis media and which had had unsuccessful results with tympanoplasty was found ineffective in 90% of the cases when applied to eustachian tubes with type V function. When this procedure was used on eustachian tubes with types III and IV function, results of 43% successes, while better than those for type V, differed greatly from the 70% success recently reported by Beck. A different group of patients with eustachian tube function of types III and IV did not receive ^{90}Sr treatment and had successful results with tympanoplasty in 76.5% of the cases at an average follow-up time of one year. (auth)

34562 CESIUM APPLICATOR FOR THE TREATMENT OF SKIN CANCER. Le Roux, P. L. M.; Sealy, G. R. H. (Groote Schuur Hospital, Cape Town. Univ. of Cape Town). Radiology; 95: 157-60(Jul 1970).

A simple universal applicator for the treatment of skin cancer is described that uses a single radioactive ^{137}Cs source and a conical filter producing flat isodoses parallel to the base of the applicator. A common single source may be used for applicators of different sizes, offering an advantage over more conventional radium mold. (auth)

Blast and Thermal Effects

Refer also to abstracts 34723 and 34735.

34563 THYROID NODULES AS A LATE EFFECT OF EXPOSURE TO FALLOUT. Conard, R. A. (Brookhaven National Lab., Upton, N. Y.); Sutow, W. W.; Colcock, B. P.; Dobyns, B. M.; Paglia, D. E. pp 325-36 of Radiation-Induced Cancer. Vienna; International Atomic Energy Agency (1969). (BNWL-13559).

From Symposium on Radiation-Induced Cancer, Athens, Greece. See STI/PUB-228; CONF-690404.

Multiple nodules of the thyroid gland have developed in a Marshallese population 10 to 14 years after accidental exposure to radioactive fallout. The exposure occurred in 1954 when an unpredicted shift in winds caused deposition of fallout on several Marshall Islands east of Bikini. Sixty-four people received 175 rads of gamma radiation which proved to be sub-lethal but resulted in early nausea and vomiting and significant depression of blood elements. Exposure of the skin resulted in beta burns and epilation, and there was significant internal absorption of fission isotopes from contaminated food and water. The most serious internal exposure was from radioiodines (^{131}I, ^{132}I, ^{133}I, ^{135}I). It was estimated that in addition to the gamma radiation the adult thyroid gland received 160 rads from radioiodines and the young children, because of their considerably smaller glands, an estimated 700–1400 rads. Recovery of blood elements to nearly normal and healing of skin lesions with regrowth of hair was complete by one year. These findings have been fully documented. The most important late radiation effect has been the development of thyroid abnormalities. Since 1963 a total of 20 cases have thus far been detected, 17 in children exposed at less than 10 years of age (90% of that group) and 3 in adults. Thyroid surgery on 11 children and 3 adults revealed that all had benign adenomatous nodules except for a mixed papillary and follicular carcinoma in a 40-year-old woman. The benign nodules were similar to those associated with iodine deficiency, but such deficiency was not apparent in the Marshallese who live largely on seafood. However, most pathologists could not distinguish definite radiation effects in the nodules. Growth and development retardation in some of the exposed children is now clearly related to thyroid deficiency. Two boys with the greatest growth retardation developed pronounced hypothyroidism with atrophy of their thyroid glands. Treatment of the exposed group with thyroid horomone appears to be enhancing growth in the children and reduced nodule formation in a few cases. Hopefully such treatment will also reduce the risk for development of thyroid cancer since this group undoubtedly has a higher risk for such malignancy. Results of a medical survey of these people carried out in March 1969 are also presented. (auth)

34564 CYTOGENETIC STUDIES ON FISHERMEN EXPOSED TO FALLOUT RADIATION IN 1954. Ishihara, Takaaki; Kumatori, Toshiyuki (National Inst. of Radiological Sciences, Chiba, Japan). Idengaku Zasshi, Suppl.; 44: No. 1, 242-51(Jul 1969).

From 12th International Congress of Genetics, Tokyo, Japan. See CONF-680844.

The Japanese fishermen under study were exposed to radiation from radioactive fall-out from nuclear bomb test explosions at Bikini in 1954. These men were irradiated externally from the radioactive materials deposited on the boat, internally from those materials entering various organs and by those adhering to the body surface. The externally irradiated dose for each person was estimated as approximately 200 to 600 rad. The estimation of the internally irradiated dose was difficult. They showed symptoms of acute radiation sicknesses following the exposure. The chromosomes of cultured lymphocytes have been studied annually since 1964, and in 1966 direct bone marrow examination was started. Each annual examination included 13 to 16 persons, and most of them were followed-up in successive examinations. Observations in lymphocytes were made at 48, 72 and 96 hrs in culture. The results of the four annual examinations in cultured lymphocytes were as follows: The frequencies of aneuploid cells varied from approximately 2% to 6%, the mean value being around 3%. The value was not statistically different from that observed in the normal population. Cells with unstable chromosome abnormalities such as dicentrics, rings or fragments were observed in some cases at frequencies as low as 0.4%. It was especially noted that cells with stable abnormalities such as translocations, inversions or deletions occurred in every case, the mean value being about 3%. These frequencies of aberrations were fairly constant in a series of the observations. Thus, the majority of the abnormal cells present in the fishermen more than 10 yr after irradiation were revealed to be so-called "stable" cells. These stable cells possess specific features in their chromosome constitutions. Nearly half of the stable cells so far observed had a balanced chromosome constitution, making the overall chromosome material apparently comparable to that of a diploid cell. About $\frac{1}{3}$ of the stable cells showed a deletion in the chromosome constitution, and the remaining about 8% possessed more chromosome material than a diploid set. Deletions in the deleted type of cells were occurring non-randomly, and a G chromosome was most frequently involved in the abnormality. These results of the karyotypic analysis of the stable cells seem to indicate that deleted type of cells should have very few chances to survive, except for those accompanied by a deletion on only limited parts of chromosomes. Likewise, cells with excessive chromosome material should also have a disadvantage for persistence due to the genetic imbalance caused by the presence of the extra chromosome material. Thus, not all the so-called "stable" cells are capable of survival, simply because they have no mechanical difficulties for cell division. Karyotypic constitution with genetically essential material is regarded to be an important factor for the life of a cell. In spite of specific features in stable cells, however, karyotypes shown by the individual cells were various, and clonal cells characterized by identical abnormalities were seldom encountered in the lymphocytes. Direct bone marrow examination was made in 4 cases in 1966 and in 11 cases in 1967. Frequency of aneuploid cells was about 6%, which was nearly twice as high as that in the peripheral blood. Cells with chromosome abnormalities were observed in 3 of the 4 cases of 1966 samples and 3 of the 11 cases of 1967 samples. All of these abnormal cells in the bone marrow were limited to stable types. It was revealed that these stable cells in the bone marrow were limited to a small number of clones. For example, in one case which showed the highest abnormal frequency, 12 out of the 15 stable cells found in the bone marrow were identical in karyotype, and the remaining 3 cells also showed an identity with another

abnormality. In the peripheral lymphocytes of the same case, none of the 24 stable cells observed there showed any identical karyotype. The differences shown in the abnormal cells in the bone marrow and in the peripheral lymphocytes might not be due to the fundamental differences of the cells, but rather to the situational differences these cells belong to; namely, one being constantly dividing cell group and the other being seldom dividing cell group. The specific features seen in the karyotypes of the stable cells in the lymphocytes seem to indicate that cell divisions did occur a certain number of times and selection did operate on them, even though the degree might have been far less severe than in the bone marrow. The presence of stable cells forming clones in vivo, in dividing marrow cells, may have a significant implication in various late effects of radiation. (M.M.B.)

34565 BIOLOGICAL IMPLICATIONS OF THE CYTOGENETIC STUDIES OF A-BOMB SURVIVORS. Bloom, A. D.; Hamilton, H. B. (Atomic Bomb Casualty Commission, Hiroshima and Nagasaki). Idengaku Zasshi, Suppl.; 44: No. 1, 252-7(Jul 1969).

From 12th International Congress of Genetics, Tokyo, Japan. See CONF-680844.

We have been doing cytogenetic studies of heavily exposed A-bomb survivors of different ages, and of their progeny, including those who were in utero at the time of the bombings. The evidence accumulated to date indicates that exchange-type aberrations are present in 35 to 61% of those survivors directly exposed to more than 200 rad of mixed gamma and neutron radiations. Over-all, the frequency of cells with these aberrations has been about 1%. It has been further established that in exposed survivors, the frequency of cells with "unstable-type" abnormalities (Cu cells, involving dicentrics, rings, fragments) has remained relatively constant throughout all age groups studied: 0.4 to 0.5%. In contrast, the frequency of cells with "stable-type" aberrations (Cs cells, involving translocations and inversions) was much increased among older irradiated survivors. In controls, Cu cells have been rarely seen. Cs cells, on the other hand, do occur occasionally in normal, older persons. Morphologically identifiable clones of cells with the same translocations or inversions have now been found in 10 older exposed survivors. The appearance of such clones suggests that some cells with radiation-induced aberrations have divided in vivo post-irradiation. One major stimulus for in vivo division of this lymphocyte population is exposure to specific antigens to which the cells are sensitized. While this may result in elimination of some aberrant cells, it may also result in the formation of clone. Among the in utero exposed whose mothers had more than 100 rad estimated exposure dose, the frequency of cells with complex exchange-type aberrations (Cu & Cs cells) was 0.6%; while in controls, the frequency was 0.04%. Damage to lymphocyte precursors, or stem cells, probably accounted for the presence of aberrations in three first trimester exposed survivors. Damage to mature cells of the immunologically competent and long-lived lymphocyte population probably accounted for these same types of aberrations being detected in second and third trimester exposed persons. The degree of dose attenuation attributable to maternal shielding is difficult to assess, but the fetal doses were undoubtedly well under those received by the mothers. The radiation sensitivity of human germ cell chromosomes was evaluated by us in a study of the offspring of the exposed, and is reported in another paper in this symposium. The implication of large numbers of persistent chromosomal abnormalities in a sizeable human population is now being considered in relation to the risk of development of somatic cell, and particularly of malignant, disease. The need for continued long-term evaluation, both cytogenetic and clinical, of the survivors of Hiroshima and Nagasaki is clearly indicated. (auth)

Radiation Effects on Animals

Refer also to abstracts 33826, 34135, 34155, 34247, 34270, 34271, 34276, 34289, 34396, 34417, 34541, and 34786.

34566 (BNL-14610) RADIOBIOLOGICAL EXPERIMENTS WITH FISSION SPECTRUM NEUTRONS FROM ^{252}Cf. Atkins, Harold L.; Fairchild, Ralph G.; Drew, Ruth M.; Robertson, James S. (Brookhaven National Lab., Upton, N. Y.). [1969]. 10p. (CONF-700507-1). Dep. CFSTI.

From 10th International Cancer Congress, Houston, Tex.

Experiments were carried out on the relative effects of γ radiation (^{226}Ra and ^{137}Cs) and ^{252}Cf on cells in tissue culture with regard to RBE, LET, dose rate effects, and oxygen enhancement ratio. Irradiations carried out in tissue-equivalent phantoms at 31 rads/hr with ^{226}Ra and 16 rads/hr with ^{252}Cf resulted in an RBE of 2.9 for the ^{252}Cf with respect to ^{226}Ra. HeLa cells were irradiated with ^{252}Cf at dose rates of 9.09 and 6.15 rads/hr, and ^{235}U fission neutrons were administered at 25.2 rads/min. Californium-252 injuries to cells resulted from the neutron or high LET component. Chinese hamster cells were used in similar studies. Effects of protracted irradiation with ^{252}Cf and ^{226}Ra on skin of pigs were studied. It was found that the RBE for ^{252}Cf was 4.9. Advantages of ^{252}Cf as a source of neutrons for radiotherapy of tumors in order to overcome unfavorable effects of anoxia are pointed out. (H.L.W.)

34567 (LF-41) FISSION PRODUCT INHALATION PROGRAM. Annual Report, September 1968-September 1969. McClellan, R. O.; Rupprecht, F. C. (eds.) (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.). Nov 1969. Contract AT(29-2)-1013. 249p. Dep. CFSTI.

Thirty-two papers which form the annual report of the Fission Product Inhalation Program for studying the biological consequences of inhaling radioisotopes are presented. Separate abstracts were prepared for 23. Nine were not within the scope of NSA. (L.C.L.)

For abstracts of individual sections see: 33759, 33789, 33790, 34018-34027, 34237, 34302, 34317, and 34620-34626.

34568 IN-VITRO SYSTEM FOR RADIOCARCINOGENESIS. Klein, Joosje C. (Radiobiological Inst. TNO, Rijswijk Z. H., Netherlands). pp 57-66 of Radiation-Induced Cancer. Vienna; International Atomic Energy Agency (1969).

From Symposium on Radiation-Induced Cancer, Athens, Greece. See STI/PUB-228; CONF-690404.

Cells of a non-malignant cell line, derived from the spleen of a 2-day-old (C57BL/Rij × CBA/Rij) F_1 mouse, were cultured in a rigidly controlled monolayer system and used as target cells for the induction of malignant transformation. Malignancy was tested in vivo. Long-continued weekly x-irradiation with 100, 200, and 300 rads to give accumulated doses exceeding 15,000 rads failed to induce malignant transformation. However, introduction in the culture medium of 20-methylcholanthrene (M C) at concentrations of 5 to 0.001 μg/ml and urethane (100 μg/ml) gave rise to malignant cell transformation. Cells treated with 5 μg/ml urethan alone or in combination with weekly doses of 100 rads of x rays remained non-malignant. The implications of these findings are discussed. (auth)

34569 CELL PROLIFERATION AND RADIOSENSITIVITY OF TRANSPLANTABLE ANIMAL TUMOURS. Hug, O.; Von Szczepanski, Lore (Institut fuer Biologie der Gesellschaft fuer Strahlenforschung, Neuherberg, Ger.). pp 85-95 of Radiation-Induced Cancer. Vienna; International Atomic Energy Agency (1969).

From Symposium on Radiation-Induced Cancer, Athens, Greece. See STI/PUB-228; CONF-690404.

Autoradiography after ^{3}H-thymidine incorporation shows that various transplantable animal tumors are characterized by a spatial pattern of cell proliferation which changes with age and size of the tumors. In a well-differentiated mouse adenocarcinoma proliferation is restricted to a small peripheral zone of the tumor strands. In the Walker carcinoma of the rat and other tumors of similar growth characteristics mitotic activity is preferentially located close to the blood vessels. After irradiation as well as after treatment with cytostatic agents acute cell death is observed in the proliferating zones only. Non-proliferating parts of the parenchyma are extremely resistant. These tumors show regressive changes several days after treatment but apparently as secondary consequences of tissue damage and metabolic disturbance. The cell kinetics and return of proliferative activity were determined by autoradiography and measurement of tumor growth, respectively, after single and fractionated irradiation for each tumor type. (auth)

34570 X-RAY IRRADIATION OF THE INNER EAR OF THE GUINEA PIG. EARLY DEGENERATIVE CHANGES IN THE VESTIBULAR SENSORY EPITHELIA. Winther, F. Oe. (Rikshospitalet, Oslo. Univ. of Oslo). Acta Oto-Laryngol.; 68: 514-25(1969).

X-ray irradiation in single doses was applied to the inner ear of guinea pigs. The vestibular sensory epithelia were examined by light microscopy using the surface specimen technique. The degeneration of sensory cells was found after exposure to 6000 and 7000 R. The sensory cells in the periphery of the cristae ampullares and the maculae sacculi and utriculi were most susceptible to damage. The number of degenerated sensory cells was slightly higher in the cristae ampullares and the macula utriculi than in the macula sacculi. Most of the degenerated sensory cells seemed to be of the type II. The first sign of degeneration was a coarse granulation of the nucleus. Further signs of degeneration were

pycnosis of the nucleus and a spiderlike structure in the cuticular region. The first sign of degeneration was found after an interval of three hours from the exposure. Completely degenerated cells were found after an interval of eighteen hours from the exposure. No pathological changes were noted in the supporting cells. Exposure to 2000 and 4000 R was not followed by visible changes. (auth)

34571 STUDIES ON COMBINED EFFECTS OF RADIATION AND ANTITUMOR AGENTS ON KB CELLS. 1st REPORT. THE EFFECTS OF COMBINED USE OF 5-FLUOROURACIL OR MITOMYCIN C AND X-RAY RADIATION. Kajiyama, Minoru; Koga, Hisayasu (Kyushu Dental Coll., Fukuoka). Kyushu Shika Gakkai Zasshi; 23: No. 1, 76-85(1969). (In Japanese).

It is the purpose of this paper to report the time factor for the combined effects of x ray and antitumor agents. A study has been conducted in vitro on cultured KB cells from the two standpoints, namely the cell survival rate and morphologic changes. The results obtained are as follows: In 5-fluorouracil (5-FU) or mitomycin C (MMC) treatment to KB cells, given before or after x radiation, only additive inhibitory effects are shown, regardless of numbers of treatment of 5-FU or MMC. In combined treatment of 5-FU or MMC with x radiation for KB cells simultaneously, geometrical inhibitory effects are observed. From the morphologic studies, the most intensive inhibitory effects are seen in the experimental series of simultaneous treatment of 5-FU or MMC and x radiation. As far as our experimental series are concerned, no significant difference in inhibitory effects are noted by combined treatment of x radiation with either 5-FU or MMC. (auth) (NSA of Japan)

34572 ULTRAVIOLET FLUORESCENCE OF BIOLOGICAL OBJECTS EXPOSED TO IONIZING RADIATION. Aleksandrov, S. N.; Brumberg, I. E.; Vorobtsova, I. E.; Kondrateva, T. M.; Safronova, V. G.; Yagunov, A. S. Kosm. Biol. Med.; 4: 66-72(Jan-Feb 1970). (In Russian).

The effect of ionizing radiation on the uv fluorescence of biological objects was investigated. High priority was given to mammalian cells in which a mass hereditary character of radioinduced mutations was revealed: the level of cell fluorescence increased due to those changes. (auth)

34573 INFLUENCE OF X-IRRADIATION ON CELL DIFFERENTIATION. Frankfurt, O. S. (Inst. of Chemical Physics, Moscow). Tsitologiya; 12: 123-7(Jan 1970). (In Russian).

The C_3HA line mice were injected ^3H-thymidine intraperitoneally and after 1 or 12 hr were subjected to a whole-body x irradiation. The following indexes were determined on the autoradiographs of the forestomach 24 to 60 hr after injection: percentage of labeled spinous and granular cells of all the labeled cells, and of labeled granular cells of all the labeled differentiated cells. A comparison of these indices in control and irradiated mice groups allowed the following conclusions. The irradiation with 600 R performed at the beginning of the maturation phase inhibited cell differentiation, whereas irradiation with 2000 R at the same period had no influence on cell differentiation. Cells irradiated with 2000 R during S phase failed to divide within 48 hr. Part of these cells differentiated more rapidly. A majority of cells, irradiated during S and G_1 phases failed to differentiate during 60 hr following irradiation. The role of cell differentiation in the radiosensitivity of renewing populations is discussed. (auth)

34574 ACTIONS CHIMIQUES ET BIOLOGIQUES DES RADIATIONS. (Chemical and Biological Action of Radiations). Haissinsky, M. (ed.). Douzieme Serie. Paris; Masson et Cie, Editeurs (1968). 344p. 148 F. (In French and English).

Separate abstracts were prepared for each of the six sections of the book. An author and a subject index are provided and an outline of the material is given. (C.O.)

For abstracts of individual sections see: 34099, 34155, 34541, 34575, 34786, and 34787.

34575 MODIFICATION OF CELLULAR KINETICS BY IONIZING RADIATION. Nias, A. H. W.; Lajtha, L. G. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). pp 95-144 of Actions Chimiques et Biologiques des Radiations. /Haissinsky, M. (ed.). Paris; Masson et Cie, Editeurs (1968).

The common ground between the study of cell population kinetics and cellular radiobiology is reviewed and current radiobiological information is related to current studies of the kinetics of cellular proliferation. The various methods available for the study of kinetics of cellular proliferation is discussed first. The discussion is followed by a description of various types of cell populations (proliferating, nonproliferating, and steady-state). The different methods of analyzing radiation effects at the cellular level are then outlined. In conclusion, the different methods available for the study of cellular proliferation and analysis of radiation effects at the cellular level are applied to each type of cell population. (247 references) (C.O.)

34576 EFFECTS OF LIGHT ON VIABILITY AND DNA SYNTHESIS OF MAMMALIAN CELLS PREINCUBATED IN MEDIA CONTAINING BROMINATED PYRIMIDINES. Yang, S. J.; Hahn, G. M.; Van Kersen-Bax, I. (Stanford Univ., Calif.). Photochem. Photobiol.; 11: 131-6(Feb 1970).

It was found that visible light strongly modified the rate of DNA synthesis of cells having 5-bromodeoxyuridine (BUdR) incorporated into their DNA. The effects were two-fold; normal DNA synthesis (S phase) was reduced and unscheduled synthesis (non-S phase) was initiated. Depending on the ratio of the number of cells in S phase to those in other parts of the cell cycle, light either increased or decreased the rate of DNA synthesis. Light effects on BUdR and BCdR (5-bromodeoxycytidine) cells were essentially the same. Chinese hamster ovary cells were used and rates of DNA synthesis were measured using tritiated thymidine (^3H-TdR) and ^{14}C-TdR. (UK)

34577 RADIOSENSITIVITY OF MOUSE CELLS OF FOETAL LIVER ORIGIN IN THE COURSE OF THEIR MULTIPLICATION CYCLE. Duplan, J. F.; Monot, P. (Institut du Radium, Paris). Int. J. Radiat. Biol.; 17: 297-301(1970). (In French).

The following aspects were investigated: the correlation between the radiosensitivity and the percentage of cells of foetal liver origin in phase S; the relationship between the elimination of cells in phase S by the suicide effect of tritium-labeled thymidine (^3HTdR); and the change in radiosensitivity of the residual population. (UK)

34578 THE FATE OF INFLUENZA VIRUS RNA IN CELLS TREATED WITH ULTRAVIOLET RAYS. Ghendon, Yu.; Ginsburg, V. P.; Solov'ev, G. Ya.; Markushin, S. G. (Moscow Research Inst. for Virus Preparations). J. Gen. Virol.; 6: 249-55(1970).

The fate of [^{14}C]RNA of fowl plague virus was studied in unirradiated and u.v.-irradiated cultures of chick embryo fibroblasts. U.v.-irradiation of cells at wavelength 2537 Å did not prevent virus penetration into the cell and deproteinization of virus RNA and its penetration into the cell nucleus. However, RNA penetrating into nuclei of irradiated cells underwent practically complete degradation. RNase activity increased two- to threefold in the nuclear fraction of irradiated cells. This RNase may participate in the process of degradation of virus RNA in nuclei of irradiated cells. (auth) (UK)

34579 THE RESTORATIVE EFFECT OF ADENINE ON RADIATION DAMAGE IN RAT THYMOCYTES. Ohyama, H.; Yamada, (National Inst. of Radiological Sciences, Chiba, Japan). Int. J. Radiat. Biol.; 17: 277-8(1970).

Results indicated that adenine added to the incubation medium after x-irradiation could restore cell viability as well as the ATP content of irradiated rat thymocytes. Radiation was with 200 kVp x-rays, 20 mA, 0.5 mm Cu + 0.5 mm Al filters, exposure rate 400 R/m, total dose 8 kR. The cell suspensions were then incubated with 10 mM glucose and 2 mM adenine at 37°C for 4 hours, after which viable cell counts were taken. The ATP content of the irradiated thymocytes decreased to about half that of the control by 1 hour after incubation beginning, when no significant change in cell mortality occurred, then fell to 28% of the zero time value after 4 hours incubation. Addition of 2 mM adenine to the medium of the irradiated cells caused a marked increase of ATP. Irradiated thymocyte suspensions incubated with adenine contained approximately 70 per cent live cells after 4 hours of incubation, compared with 50% live cells in suspensions incubated without adenine. Inosine and adenosine were found to be less effective than adenine. (UK)

34580 SENSITIVITY OF SYNCHRONIZED CHINESE HAMSTER CELLS TO ULTRAVIOLET LIGHT. Han, Antun; Sinclair, Warren K. (Argonne National Lab., Ill.). Biophys. J.; 9: 1171-92(Sep 1969).

The age response for lethality of uv light of 2540 mμ toward Chinese hamster cells showed that they were resistant in G_1, sensitive as they moved into and through the S phase and resistant again in G_2 and mitosis. Survival curves determined at different times in the cycle revealed that mitotic cells were the most resistant fraction, much more resistant than S cells, and more resistant than either G_1 or G_2 cells. The extent to which the age response was influenced by nucleic acid and protein synthesis was investigated by using inhibitors of these processes. In the presence of inhibitors of DNA or protein synthesis added to G_1 cells before exposure, cell survival neither declined to the minimum survival of S cells nor rose subsequently to the resistance of G_2 cells. If, before exposure, DNA synthesis was arrested in the middle of S, when survival was at a minimum,

the subsequent rise in survival during G_2 was not prevented. However, when cycloheximide was added before exposure, during the middle of S, this rise was prevented. When actinomycin D, an inhibitor of RNA synthesis was added prior to exposure the age response was affected only slightly. Postirradiation treatment of G_1 and mid-S cells with inhibitors of DNA or protein synthesis maintained survival at a level characteristic of the age of the cells. (auth) (BBB)

34581 DEMONSTRATION OF RADIATION INDUCED PERCENTUAL CHANGES IN PERIPHERAL LYMPHOCYTE TYPES BY MEANS OF A CYTOCHEMICAL METHOD. Schroeder, Konrad (Univ., Freiburg i. B.); Ladner, Hans-Adolf; Pemsel, Gerda. Strahlenschutz Forsch. Prax.; 7: 311-17(1967). (In German).

Two types of lymphocytes were distinguished histochemically by the α-naphthylacetate-esterase reaction. In 45 patients receiving from 7 to 150 μC of ^{131}I both total lymphocyte count and leukocyte count decreased while the other parameters of the peripheral blood remained unchanged. The ratio of the two lymphocyte types was changed significantly after radioisotope treatment. (H.B.G.)

34582 EFFECTS OF IONIZING RADIATION ON CARBOHYDRATE METABOLISM IN LEUKOCYTES. Gerhardt, Paul (Univ., Tuebingen, Ger.). Strahlentherapie; 138: 602-6(Nov 1969). (In German).

Cellular dimensions of the granulocytes and the lymphocytes were measured with an ocular micrometer, in man and rabbits after fractionated irradiation. The cellular function was also controlled by measurement of the activity of the glycolytic enzymes 6-PGDH and G-6-PDH. In many patients an increase of the enzyme activity was observed together with an increase of the cellular dimensions during radiotherapy. In the rabbits there was a remarkable cyclic evolution of the enzyme activity and of the cellular dimensions during the irradiation experiments. The possibility of the mobilization because of the radiation stress of large granulocytes activating the metabolism, is indicated. (auth)

34583 RADIOPROTECTIVE MECHANISMS IN RADIORESISTANT TUMORS. Revesz, L.; Modig, H.; Lindfors, P. (Karolinska Institutet, Stockholm). Tr. Kaz. Nauch.-Issled. Inst. Onkol. Radiol.; 6: 36-45(1969).

An Ehrlich ascites tumor was maintained in mice and was irradiated with 2000 R under anoxic conditions before each transplant. A number of clones were derived from the tumor line after 23 serial irradiations were made. The clones were characterized according to chromosome patterns, DNA content, and content of sulfhydryl groups. These properties are tabulated for various cell lines in relation to their radiosensitivity. It was found that radioresistance was increased in diploid cells and in cells with increased sulfhydryl concentrations. The kinetics of cell populations as a factor in the development of radioresistance is discussed. The role of diploid and tetraploid cells in radiosensitivity is examined. (H.L.W.)

34584 STUDY OF THE CELL CYCLE OF EHRLICH'S ASCITES TUMOR AND ITS RADIORESISTANT SUBLINE. Tolmachov, V. S.; Efimov, M. L. (Inst. of Oncology and Radiology, Alma-Ata, USSR). Tr. Kaz. Nauch.-Issled. Inst. Onkol. Radiol.; 6: 72-5(1969). (In Russian).

The duration of the cell cycle and mitotic phases in Ehrlich ascites carcinoma and its radioresistant subline was analyzed. The mean time of the cell cycle in the original carcinoma was 25 hr and 46 min; the duration of mitosis was 19 min. The duration of the mitotic phases was as follows: prophase, 3 min; metaphase, 9 min; anaphase, 2 min; and telophase, 5 min. The mean time of the cell cycle in the radioresistant subline was 23 hr and 54 min; the duration of mitosis was 29 min. The duration of the mitotic phases was as follows: prophase, 8 min; metaphase, 10 min; anaphase, 6 min; and telophase, 5 min. (auth)

34585 INVESTIGATION OF THE SORPTION CAPACITY OF RADIOSENSITIVE AND RADIORESISTANT TUMOR CELLS. Efimov, M. L.; Yakovleva, S. S.; Arkhipova, L. D. (Inst. of Oncology and Radiology, Alma-Ata, USSR). Tr. Kaz. Nauch.-Issled. Inst. Onkol. Radiol.; 6: 76-9(1969). (In Russian).

The sorption capacity of two sublines of Ehrlich ascites carcinoma, ovarian tumors of rats, the Pliss lymphosarcoma was analyzed following a radiation dose of 1400 rad. There as a considerable increase in the sorption capacity of the ascites cells and those of the lymphosarcoma. The relationship of this property to the radiosensitivity of the cells is discussed. (auth)

34586 STUDY OF RADIOSENSITIVITY OF THE ORIGINAL AND RADIORESISTANT SUBLINE IN EHRLICH'S ASCITES CARCINOMA AFTER ITS TRANSFORMATION INTO A SOLID FORM IN CONDITIONS OF EXPLANTATION. Kuanyshbaev, K. Kh.; Nugmanov, E. U.; Adil'gireeva, P. Kh. (Inst. of Oncology and Radiology, Alma-Ata, USSR). Tr. Kaz. Nauch.-Issled. Inst. Onkol. Radiol.; 6: 80-3(1969). (In Russian).

Following irradiation in vitro, radioresistant properties of Ehrlich ascites carcinoma were observed under conditions of explantation and in the solid tumor. (auth)

34587 ENHANCEMENT OF RADIATION EFFECT BY PHENOL COMPOUNDS (INHIBITORS OF RADICAL REACTIONS) AND QUANTITATIVE APPRAISAL OF THEIR RADIOSENSITIZING ACTION. Emanuel, N. M.; Pelevina, I. I.; Afanas'ev, G. G.; Lipchina, L. P.; Burlakova, E. B. (Inst. of Chemical Physics, Moscow). Tr. Kaz. Nauch.-Issled. Inst. Onkol. Radiol.; 6: 116-24(1969). (In Russian).

Free radical inhibitors were used to increase the lethal action of ionizing radiation. The ascites tumor cells decreased in number and there was a regression of solid NKLy tumors. Statistical methods were used for analyzing effects of inhibitors on ascites tumors. A heterogeneous reaction of the tumors was demonstrated to the combined effects of free radical inhibitors and ionizing radiation. (auth)

34588 SURVIVAL CHARACTERISTICS OF TISSUE CULTURE CELLS AFTER OXIC AND ANOXIC IRRADIATION. Revesz, L.; Littbrand, B. (Karolinska Institutet, Stockholm). Tr. Kaz. Nauch.-Issled. Inst. Onkol. Radiol.; 6: 195-205(1969).

Chinese hamster cells were cultured in the presence of oxygen and under anoxic conditions in argon. Survival data of the cells following exposure to x radiation doses up to 3000 R are presented in the form of a graph. It was shown that the effects of oxygen in enhancing radiosensitivity varied with the dose. Differences in post-radiation recovery characteristics of the cells are discussed with relation to survival parameters under aerobic and anaerobic conditions. Interactions of radiation injuries induced under aerobic and anaerobic conditions are discussed. (H.L.W.)

34589 CYTOMORPHOLOGICAL CHARACTERISTICS OF RS-1 TUMOR IRRADIATED UNDER LOCAL HYPOXIA. Esel'baeva, G. O.; Akhtyamov, M. G.; Adil'gireeva, S. Kh.; Ayapbergenov, E. K. (Inst. of Oncology and Radiology, Alma-Ata, USSR). Tr. Kaz. Nauch.-Issled. Inst. Onkol. Radiol.; 6: 230-6(1969). (In Russian).

Studies were conducted on the effects of anoxia on morphological and cytological changes in RS-1 tumors irradiated with 2000 and 3000 R doses separated by an interval of 48 hrs. Dystrophy and necrosis of tumor parenchyma resulted from this method of irradiation. In addition, suppression of stroma cell response and destructive changes in fibrous elements occurred. Effects of anoxia on the mitotic index of irradiated tumor cells were observed. A direct relationship between cell quantity and the mitotic index was established. (auth)

34590 STATE OF THE TUMOR BED AFTER RADIATION THERAPY DURING LOCAL HYPOXIA. Esel'baeva, G. O.; Balmukhanov, S. B. (Inst. of Oncology and Radiology, Alma-Ata, USSR). Tr. Kaz. Nauch.-Issled. Inst. Onkol. Radiol.; 6: 237-43 (1969). (In Russian).

Effects of 2000 and 5000 R doses of radiation on the stromal state and tumor bed of transplanted tumors were studied under conditions of hypoxia. Results showed that there was an increase in the callous, fibrous, and hyaline properties of the collagen fibers, a decreased quantity of stromal cells in the connective tissue, and an increased sclerosity of blood vessels. The parenchyma and stroma of the tumor were protected against 2000 R doses by hypoxia; the collagen fibers maintained their structure, and an increase in cellular elements of the connective tissue occurred. This effect did not occur at the 5000 R dose. (auth)

34591 SOLUBLE PROTEINS OF RS-1 TUMOR IN IRRADIATION DURING TOURNIQUET ANOXIA. Mironenko, N. I.; Sulaeva, L. S.; Tungushbaeva, K. M.; Gordienko, G. P. (Inst. of Oncology and Radiology, Alma-Ata, USSR). Tr. Kaz. Nauch.-Issled. Inst. Onkol. Radiol.; 6: 248-51(1969). (In Russian).

Effects of hypoxia alone and hypoxia combined with radiation on the ratio of protein fractions in RS-1 tumors were investigated. Significant changes were observed during the growth period of the tumor. Greatest fluctuations were noted in α and β globulins. The phase characteristics of the protein fractions are discussed. (auth)

34592 THE OXYGEN ENHANCEMENT RATIO FOR X-RAY INDUCED CHROMOSOMAL ABERRATIONS IN CULTURED HUMAN LYMPHOCYTES. Watson, G. E.; Gillies, N. E. (Middlesex Hospital, London). Int. J. Radiat. Biol.; 17: 279-83(1970).

Data are presented for the yields of dicentric chromosomes found in human lymphocytes irradiated in vitro with x rays under oxygenated and anoxic conditions, and the effect of culture time on the yield of aberrations. The yield of dicentric chromosomes and Cu cells in all cultures reached a maximum after 60 hours incubation. The response curves for the oxygenated cells

fitted a combined quadratic dose-response model, but the anaerobically irradiated lymphocytes showed linear dose-response curves that differed significantly between incubation times. From the difference in curve shapes, a range of values for the oxygen enhancement ratio was found. Oxygen did not act as a true dose-modifying agent. OER values ranged from 6.2 ± 1.8 to 8.9 ± 1.7 for 0.05 to 0.25 dicentrics per cell for 50 hr cultures and from 2.8 ± 0.71 to 3.9 ± 0.58 for 0.05 to 0.25 dicentric chromosomes per cell for 60 hr cultures. (UK)

34593 IN VITRO STUDIES ON THE EFFECT OF HIGH DOSES OF IONIZING RADIATIONS (100,000 r) ON THE INTERPHASE OF FIBROBLASTS. Valentini, A. F.; Olivo, O. M. (Univ., Bologna). Boll. Soc. Ital. Biol. Sper.; 45: 547-9(15 May 1969). (In Italian).

While the response of a cell in mitotic status to ionizing radiation is prompt and striking, in the interphase it is lagging and in the beginning not manifest. Only 3 hours after irradiation with 100,000 R fibroblast tissues of embryonic chick tendons in hanging drop culture show faintly incipient patterns of radiation damage. After 12 hours one observes already 400 degenerated cells per mm^2. This pattern is most evident in the migration zone of cell division by scattered chromatin particles. Cultures fixed 12 to 24 hours after irradiation show a characteristic migratory deflection. There exists a critical phase between the 6th and 12th hour after irradiation during which the greatest number of cells disintegrates scattering chromatin material in a translucent field. Since such cellular detritus can no longer be seen 12 hours after irradiation, it must be assumed that it has been enzymatically digested. After 24 hours we have before us a practically new field of observation with irradiated cells reduced to about one tenth of their original number and new cells appearing similar to those of unirradiated controls and after 4 to 5 days the few surviving cells resume the activity of cell-division and proliferation. (F.J.W.)

34594 IN VITRO STUDIES ON THE EFFECT OF HIGH DOSES OF IONIZING RADIATION(100,000 r) ON FIBROBLAST MITOSIS. Valentini, A. F.; Olivo, O. M. (Univ., Bologna). Boll. Soc. Ital. Biol. Sper.; 45: 545-7(15 May 1969). (In Italian).

For the study of the proliferation mechanism of fibroblasts in hanging drop culture a cell culture of tendons of embryonal chickens of 14 days incubation was placed under a double mica cover. Nutrient was a composition of chick serum plasma, beef bouillon, and embryonal extract of chicks of 9 days incubation. The culture was kept in a thermostat at 37°C and subdivisions were made after 48 hours, new nutrient was supplied after another 48 and again after 12 hours; final subdivision and transfer to another culture site after 24 hours. Four sample cultures were irradiated and four remained unirradiated as controls. The irradiation took place 24 hours after transfer and was carried out with a Philips plesiotherapuetic appartus of 50 KV, 2 mA, without filter, at 2 cm distance, and at the energy of 100,000 R. The irradiated and control samples were systematically examined after fixation and staining 5, 15, and 30 min, 1, 3, 6, 12, 24, and 48 hours after irradiation. Numerous parameters were established and are shown in a synoptic table. The most important one is the count of numbers of completed mitoses per mm^2 (n). After 5 min only 28% of mitoses were normal, the rest showed various abnormalities. After 15 min only 25 mitoses were completed and all were abnormal. After 3 hours mitotic activity had decreased by 87% and no characteristic mitotic configurations were recognizable. After 6 hours complete cellular degradation into a translucent mass had taken place. Thus irradiation with 100,000 R brings about, after a relatively short lag period, a total destruction of the mitotic apparatus and no subsequent resumption of mitotic activity. This indicates that irradiation of this strength leads to complete depolymerization of nucleic acids. (F.J.W.)

Invertebrates

Refer also to abstracts 34120, 34152, 34166, 34167, 34250, 34251, 34261, 34265, 34280, 34830, 34831, 34835, and 35365.

34595 EFFECT OF IRRADIATION ON EGG FORMATION AND EGG FERTILITY OF THE MULBERRY SILKWORM. Sarkisyan, S. M.; Mashadyan, P. N. Biol. Zh. Arm.; 22: No. 9, 8-15(Sep 1969). (In Armenian).

For radiobiological studies, the mulberry silkworm has the advantage that egg formation takes place in the pupal organism which is relatively isolated from external factors, while egg development and fertilization take place in eggs deposited in the butterfly stage. Thus data on egg bearing and fertilization give information on which part of the reproduction cycle suffers most from x irradiation. The data show that the smallest egg bearing takes place in butterflies hatched from young (1 to 4 day), irradiated pupae. The younger the pupae, the stronger the effect of radiation. Egg fertilization depends strongly on the dose with a much greater negative effect in young pupae than in more mature ones at doses of 2000 to 4000 R. It is concluded that the yolk has a protective effect decreasing the negative effect of irradiation. (TTT)

34596 CYTOLOGY OF GAMMA-IRRADIATED GONADS OF STOMOXYS CALCITRANS (DIPTERA: MUSCIDAE). Offori, Evans D. (North Dakota State Univ., Fargo. Metabolism and Radiation Research Lab., Fargo, N. Dak.). Ann. Entomol. Soc. Amer.; 63: 706-12(May 1970).

Sterility, as measured by egg hatch, was obtained in the male stable fly, Stomoxys calcitrans (L.), with 4 kilorads of gamma radiation applied to pupae and 5 kilorads to adults. Cytological examination of the testes revealed that while the early stages of spermatogenesis showed several types and degrees of deformity, mature spermatozoa were not visibly affected by the sterilizing doses. A limited amount of spermatogenic activity was noticeable 5 days after treatment. However, when males were held for 10 days, all gonial cells were destroyed, an indication that radiation damage to these cells became more evident with time. Females were sterilized with 2 kilorads, both as pupae and as adults. With a dose of 3 kilorads, egg production ceased completely. Observations made of entire ovaries and ovarioles after irradiation showed that these doses not only delayed ovary growth but also produced deformities in the shapes of developing follicles and pycnosis in nurse cell nuclei. The lower dose (2 kilorads) did not stop development of the more mature oöcytes, although egg hatchability indicated that this dose produced dominant lethality in eggs that were fully formed at the time of treatment. (auth)

34597 VARIATIONS IN THE SENSITIVITY TO X-RAY-INDUCED MITOTIC DELAY DURING THE CELL DIVISION CYCLE OF THE SEA URCHIN EGG. Rustad, Ronald C. (Case Western Reserve Univ., Cleveland). Contracts AT(40-1)-2730; W-31-109-eng-78. Radiat. Res.; 42: 498-512(Jun 1970). (COO-78-204).

The sensitivity to x-ray-induced mitotic delay of the sea urchin egg was measured at different times during the mitotic cycle. In the first division cycle of Arbacia punctulata the sensitivity initially increases and then decreases biphasically to insensitivity. However, cells irradiated late in the first cycle which are not delayed at their first division are delayed in their second mitotic cycle. The rise in sensitivity with regard to the delay of the second mitosis begins during the phase of insensitivity to delay of the first mitosis and extends a few minutes into the second division cycle. The fact that the sensitivity increase cannot be described by either a linear or a first-order exponential equation is discussed with reference to Lea's classic recovery hypotheses. It is suggested that the partially repairable damage by ionizing radiation may affect two different events in prophase, whereas, nonrepairable uv damage can be measured only with respect to one mitotic event. A correlation exists between periods of sensitivity to the induction of mitotic delay and of multipolar mitoses, suggesting an influence of radiation on the multiplication of centrioles. Attention is directed to possible differences between the radiation-induced mitotic delay expressed during the prophase of the sea urchin eggs and delays found at other mitotic stages in cells which must grow as well as divide. (auth)

34598 THE INFLUENCE OF ULTRAVIOLET IRRADIATION (2537 A) ON INFUSORIA COLPODA MAUPASI. Acta Protozool.; 6: 297-307(30 Nov 1968).

Effects of irradiation of the ciliate Colpoda on the cells reactions were examined at various stages of the life cycle: in the active vegetative stage (trophonts), during the period of reproduction (reproduction cysts), and under various conditions in resting cells when the synthesis of nucleic acids is low or absent. A comparison of reaction to uv of Colpoda was made with the well-investigated Paramecium caudatum and other protozoa. The resistance of infusoria to shortwave uv light was also considered in connection with the question of life beyond the Earth. After uv irradiation (λ = 2537 Å) a delay of the first division was evident, the duration of this delay being slightly dependent on the dose. After recovery, a second delay of the cell cycle takes place and lasts for 2 to 6 days. No complete cessation of division at this period was seen even after high lethal doses. The highest percentage of deaths was found to occur on the first day after irradiation; in the later periods (up to 14 days) the percentage of mortality decreased. Damage to different cell components evoked by uv resulted in a decrease of the division rate and also in lethality. The reproduction cysts are more sensitive to uv than trophonts, the resting cysts being the next most sensitive stage. The trophonts are more sensitive to the lethal action of uv ir-

radiation than reproduction cysts. The resistance of resting cysts is much greater than that of trophonts. The desiccated resting cysts show the highest resistance to uv. Visible light eliminates the second inhibition of division but has no influence on the first period of division and on the increased survival. The mechanisms of injury and of recovery of cells are discussed. (BBB)

34599 MATING OF SCHISTOSOMA MANSONI IN VITRO. Michaels, Rhoda M. (Cornell Univ., New York). Exp. Parasitol; 25: 58-71(Aug 1969).

Sexually mature female Schistosoma mansoni maintained in vitro without males laid eggs, a small percentage of which matured as evidenced by production of viable miracidia. The rates of oviposition and maturation of eggs were significantly increased by mating. Males made anorchid by x irradiation, by prolonged in vitro maintenance, or by surgical transection mated and stimulated the rate of egg-laying and egg maturation as much as did intact males. Thus, neither mating, nor stimulation of the rate of oviposition depended on intact testes, viable sperm, or something secreted with sperm. Since anorchid males could not donate sperm for the fertilization of eggs in females maintained in vitro, the feat must have been achieved by the sperm present in the female at the time of in vitro isolation. The decay rate of sperm in females maintained in vitro was found by allowing eggs laid on each day of days 1 through 5 of in vitro life to mature separately. This decay rate was exponential with time beginning on day 2 of in vitro life. Stimulation of rate of egg maturation by anorchid males was shown to be exponentially related to the rate of egg-laying. Therefore, the increase in the percentage of eggs which matured in vitro when females were mated to anorchid males, was due only to stimulation of the rate of oviposition by these anorchid males. The normal mating position of schistosomes is anterior end to anterior end, and posterior end to posterior end. Worms were transected into equal halves. When halves of worms were allowed to mate in vitro, like halves almost always mated normally and unlike halves almost always abnormally. These observations were therefore not due to chance and require an explanation. From these results, and matings of halves of worms with whole worms of the opposite sex, and transections of males smaller and larger than halves with intact females, it was postulated that both sexes of worms have linear receptors which are used to determine mating and mating position. (H.B.G.)

34600 PRELIMINARY STUDIES ON THE ULTRASTRUCTURAL DAMAGE IN THE FLIGHT MUSCLES OF GAMMA-IRRADIATED HOUSEFLY. Nair, K. K.; Bhakthan, N. M. G. (Simon Fraser Univ., British Columbia, Can.). Int. J. Radiat. Biol., 16: 397-9 (1969).

Adult male houseflies less than 24 hours old were irradiated in a ^{60}Co source with 10,000 or 20,000 Rads at a dose-rate of 93,000 Rads per hour. After irradiation the flies were maintained on a 10% sucrose solution in water. Four days after irradiation, the median longitudinal flight muscles were dissected out in cold 3% gluteraldehyde, and post-fixed for 2 hours in 2% osmium tetraoxide in veronal buffer pH 7.4. The tissues were dehydrated in ethanol grades and processed for electron microscopy. The ultrastructure of the median longitudinal flight muscles of the housefly show the typical characteristics of a fibrillar muscle. The space between the myofibrils is packed with large dense mitochondria. In the muscle exposed to 10,000 Rads the sarcoplasmic reticulum shows signs of vacuolization. After 20,000 Rads the damage becomes much more conspicuous as many vacuoles appear in the sarcoplasmic reticulum. Associated with these changes, the mitochondria show signs of disintegration. (auth) (UK)

34601 THE EFFECTS OF X-IRRADIATION AND ANTIBIOTICS ON THE SUSCEPTIBILITY OF AEDES TOGOI AND A. AEGYPTI TO SUBPERIODIC BRUGIA MALAYI AND B. PAHANGI. Ahmed, S. S. (Liverpool School of Tropical Medicine). Ann. Trop. Med. Parasitol.; 63: 353-7(1969).

The influence was studied of x irradiation on the development of subperiodic Brugia malayi and B. pahangi in Aedes togoi and in three naturally refractory and one genetically selected highly susceptible strain of A. aegypti. Irradiation had no effect on the development of B. malayi in A. aegypti or of B. pahangi in A. togoi and A. aegypti. In irradiated A. togoi infected with B. malayi the infection rate was significantly higher than in untreated controls. The influence was also studied of the antibiotics benzylpenicillin, oxytetracycline, tetracycline and demethylchlortetracycline on the development of B. pahangi in A. togoi and in two naturally refractory strains of A. aegypti. No effects on development were observed. (auth)

34602 EFFECT OF RADIOACTIVE RADIATIONS ON THE LIFETIME OF SPERMS. Niedetzky, A.; Lajtai, Cs. (Medical Univ., Pecs, Hungary). Acta Biochim. Biophys. (Budapest); 4: 211-16(1969).

The effect of β and γ radiation on the motility and lifetime of isolated mature frog sperm was determined. A ^{90}Sr–^{90}Y preparation of 86 mCi activity was used as a source of β radiation. The dose rate was 48 rad/hr at the surface. The effect of irradiation was examined in the dose range from 20 to 1200 rad. A ^{60}Co preparation equivalent to 35 g Ra was used as a source of γ radiation. The dose rate of γ irradiation was 3100 rad/hr and dose range from 0 to 1600 rad. The number of motile sperms was determined before irradiation and once a day after irradiation. Beta irradiation at all doses tested decreased the motility of the sperm significantly; γ irradiation was effective in doses over 800 rad. The experiments showed that β radiation exerts an effect in doses of one order of magnitude lower than does γ radiation. A correlation could be demonstrated between the effect and the dose of radiation. The radioresistance of β and γ radiation of mature sperm is smaller than the values found in the literature for x radiation. (BBB)

34603 EFFECTS OF GAMMA RADIATION ON THE EGG STAGE OF THE LESSER COTTON LEAF WORM, SPODOPTERA EXIGUA (Hb.). El-Badry, E. A.; Wakid, A. M.; Zaki, M. M.; Ahmed, M. Y. Y. (Ain Shams Univ., Cairo). Z. Angew. Entomol.; 64: 411-18(Dec 1969).

When both 1- and 3-day-old eggs were treated with different doses of gamma radiation, the percentage mortality increased progressively as the dose was increased. Fractionation of the lethal doses of both young and old eggs into 2 or 3 equal fractions reduced the percentage mortality of eggs. Larvae from treated eggs suffered from delaying of their development in the subsequent developmental stages. The third and fifth instar larvae showed reduction in their weight, body length and head capsule width. Such reduction increased with the increase of dose. Irradiation of eggs caused retardation of the development of immature stages. Percentage pupation, pupal weight and adult emergence were reduced as the dose was increased. Fecundity, fertility and longevity of adults produced from irradiated 1-day-old eggs were reduced, and the resulting adults showed some morphological abnormalities. However, irradiation of 3-day-old eggs did not show a clear effect on longevity, and the fecundity was stimulated at 1000 and 2000 rad, while fertility was greatly reduced. With the dose 4000 rad applied to the 3-day-old eggs, all the emerged males were malformed and the sex ratio was 3 : 1 in favor of males. (auth)

34604 CONTRIBUTION TO THE STUDY OF THE DEATH AND STERILITY INDUCED IN DROSOPHILA MELANOGASTER BY ULTRAVIOLET RADIATION OF THE POLE CELLS OF THE EGG. I. LETHAL ACTION. Moreno, Felipe (Institut de Microbiologie, Orsay, France). Int. J. Radiat. Biol.; 16: 441-50(1969). (In French).

The pole cells of the egg of D. melanogaster were irradiated with several doses of uv light, and the capacity of the eggs to form imagos was studied. The experiments have shown that: the sex of the egg does not influence its radio-sensitivity; eggs of different genotypes show identical radio-sensitivities; the survival curves are sigmoidal; the time necessary to reach the adult state is lengthened by the irradiation. Interpretations of this mortality are proposed: it could be due either to the production and diffusion of toxic substances inside the embryo, or to the diminution of the number of intact pole cells, part of which have been killed or rendered unable to fulfill their normal embryologic destiny as calicocytes. (auth) (UK)

34605 CONTRIBUTION TO THE STUDY OF THE DEATH AND STERILITY INDUCED IN DROSOPHILA MELANOGASTER BY ULTRAVIOLET RADIATION OF THE POLE CELLS OF THE EGG. II. STERILISING ACTION. Moreno, Felipe (Institut de Microbiologie, Orsay, France). Int. J. Radiat. Biol.; 16: 451-65 (1969). (In French).

The sterilizing action of uv light on D. melanogaster was studied. Egg pole cells, taken at the blastoderm stage, received increasing doses of uv: 500, 600, 1000, 1500, and 2000 ergs/mm^2. The following results were observed. The curves giving the loss of fertility as a function of uv dose were sigmoidal. Females were more radiosensitive than males. The percentage of fertility of females that received a dose of 500 ergs/mm^2 was 85.2 ± 3.2 and 52.? ± 2.5 after a dose of 1000 ergs/mm^2. Though the quantity of surviving primordial germ cells varied from one fly to another, the mean was the same at both doses. It was evident that, at least for the females, an independent inactivation of all the primordial germ cells is not a necessary condition for the induction of sterility. Several hypotheses are proposed to explain these results; the most probable one is related to disturbances due to the irradiation brought about in the morphogenetic movements which bring these cells into the gonad rudiments. (auth) (UK)

34606 DEVITALIZATION OF CYSTICERCI BY GAMMA RADIATION. Pawel, O. (Veterinary Research Inst., Prague).

pp 91-4 of Elimination of Harmful Organisms from Food and Feed by Irradiation. Vienna; International Atomic Energy Agency (1968).

From Panel on Elimination of Harmful Organisms from Food and Feed by Irradiation, Zeist, Netherlands. See STI/PUB-200; CONF-670671.

Devitalization of cysticerci is feasible by ionizing radiation. This was tested on Cysticercus bovis, C. cellulosae and C. pisiformis. To judge the vitality of the cysticerci, the classical method for examining conditionally fit for consumption meat was used. In addition, the modified method for culturing the Taenia in artificial media was used. Many cysticerci were devitalized after γ irradiation with doses of 10 R from ^{60}Co. The optimal dose required to devitalize all the cysticerci was found to range from 400,000 to 500,000 R. (auth)

34607 ACCOUNT OF RESEARCH ON SOMATIC AND GENETIC EFFECTS OF RADIATION ON MARINE AND FRESH WATER ORGANISMS UNDERTAKEN IN THE FEDERAL REPUBLIC OF GERMANY. Hoppenheit, M. (Biologische Anstalt Helgoland, Hamburg). pp 121-3 of Proceedings of the Seminar on Marine Radioecology. Paris; European Nuclear Energy Agency (1969).

See CONF-681225.

Effects of radiation doses of 2,000 to 20,000 R on growth, fertility, and survival of the annelid, Ophryotrocha puerilis, were studied and effects of doses of 250 to 2,000 R on mortality of 2 to 10 day old eggs were observed. For hybridization and inbreeding experiments, guppies were irradiated with 500 and 1,000 R. Brood size, postnatal mortality, sex ratio, and development of abnormalities were used as criteria of mutagenic effects of radiation. Effects of radiation on the hatching rate of rainbow trout were studied. Larvae of pike irradiated as embryos showed temporary malformations and survived only until the yolk supply was consumed. Radiation doses of 2500 to 5500 R administered to carp resulted in atrophy of the gonads. Effects of 625 to 20,000 R on molting and survival of the crustacean, Gammarus, were investigated. (H.L.W.)

Vertebrates

Refer also to abstracts 34017, 34027, 34031-34033, 34073-34076, 34078, 34081-34084, 34092, 34093, 34095-34097, 34100, 34112, 34113, 34115, 34116, 34119, 34120, 34122, 34124, 34126, 34127, 34130, 34143, 34153, 34154, 34157, 34158, 34161-34165, 34168, 34169, 34171, 34174-34177, 34228, 34229, 34237, 34245, 34317, 34373, 34395, 34397-34402, 34404-34406, 34410, 34415, 34416, 34422, 34423, 34425, 34548, 34549, 34550, and 34804.

34608 (ANL-Trans-804) CHROMOPROTEINS AND RADIATION SENSITIVITY. Balmukhanov, S. B.; Utesheev, A. B. Translated for Argonne National Lab., Ill., from Izv. Akad. Nauk Kaz. SSR, Ser. Biol.; 6: No. 3, 57-63(1968). 12p. Dep. CFSTI.

A total x-ray dose of 900 R produced definite changes in the activities of chromoproteins in certain organs and tissues of animals, these disturbances being more pronounced and more persistent in radiation-sensitive animals (guinea pigs) compared to relatively radiation-resistant animals (rats). During the early period of radiation sickness, a reduction in the number of erythrocytes and of the hemoglobin value in the peripheral blood was accompanied by a decrease in catalase activity, reaching a minimum 24 and 48 hr after irradiation. In this case there was an increase in true peroxidase activity which was more pronounced in the blood of guinea pigs. In the tissues of irradiated rats, there was primarily a reduction of catalase activity, while in guinea pigs these changes had a phasic character and they depended on the stage of evolution of radiation sickness. The cytochrome C level increased in the liver and spleen of irradiated animals. The maximum level of this enzyme is found 12 to 24 hr after irradiation in certain tissues. The succinic dehydrogenase activity increased in the liver, brain and lungs of rats, while it decreased in the kidneys and heart muscle. This change was especially pronounced in the organs of irradiated guinea pigs. (auth)

34609 (BNL-tr-316) PATHOGENESIS OF DELAYED IRRADIATION DAMAGE TO THE SPINAL CORD. Zeman, Wolfgang. Translated for Brookhaven National Lab., Upton, N. Y., from Strahlentherie, Sonderbaende; 62: 138-42(1962). 15p. Dep. CFSTI.

The pathogenesis of delayed radionecrosis of the spinal cord is predominantly determined by the somatic mutations in the interstitial cells, caused during irradiation. These mutations that individually lead to quite different functional disturbances in the cells impair the functional capacity and adaptability of the irradiated tissue. This metabolic insufficiency is progressive, inasmuch as the increased mitotic activity induced by irradiation leads to a continuing aggravation of the damage to the genomes. The time after which the delayed necrosis develops, the so-called period of latency, is inversely proportional to the biologically active dose, as was proved by controlled animal experiments. This offers the possibility of recognizing a modification of the effects of irradiation by a change in the duration of the latent period. It was possible to show that not only do the biological conditions which prevail during irradiation determine its effectiveness, but that a number of pathological processes, which exert their effects during the postirradiation period, shorten the period of latency. Individual radiosensitivity is discussed. (auth)

34610 (BNWL-1050(Pt.1), pp 1.3-6) SODIUM LOSS IN THE IRRADIATED RATS. Sullivan, M. F. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

From Pacific Northwest Laboratory annual report for 1968 to the USAEC Division of Biology and Medicine. Vol. I. Life sciences. Pt. 1. Biological sciences.

A substantial sodium loss was demonstrated in x irradiated rats by measurements of whole-body retention and urinary excretion of injected ^{22}Na. The quantity of ^{22}Na retained was more affected by sodium intake than by radiation. (auth)

34611 (BNWL-1050(Pt.1), pp 1.6-8) WATER AND ELECTROLYTE ABSORPTION AND EXCRETION FROM THE INTESTINE OF SODIUM-DEFICIENT AND/OR IRRADIATED RATS. Sullivan, M. F. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

From Pacific Northwest Laboratory annual report for 1968 to the USAEC Division of Biology and Medicine. Vol. I. Life sciences. Pt. 1. Biological sciences.

Sodium and water movement into and out of the small intestine was measured in rats maintained on a low- or high-sodium intake. X irradiation reduced insorption (lumen to blood) and caused a net accumulation of sodium in the lumen regardless of the sodium balance of the animal prior to exposure. (auth)

34612 (BNWL-1050(Pt.1), pp 1.9-11) INTESTINAL RADIATION INJURY IN MINIATURE SWINE. Wachholz, B. W.; Mahony, T. D.; Sullivan, M. F. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

From Pacific Northwest Laboratory annual report for 1968 to the USAEC Division of Biology and Medicine. Vol. I. Life sciences. Pt. 1. Biological sciences.

Acute deaths were seen in miniature swine that received more than 400 R whole-body exposure or more than 2700 R lower-body exposure to ^{60}Co γ radiation. Preliminary histopathologic observations suggest that the ileum was usually the most radiosensitive area of the intestinal tract followed in varying degrees by the cecum, colon, and jejunum, with the duodenum being least radiosensitive. This order is in contrast to that usually reported for other laboratory species. (auth)

34613 (BNWL-1050(Pt.1), pp 1.12-14) INTERSPECIES COMPARISON OF GASTROINTESTINAL RADIATION EFFECTS. Sullivan, M. F.; Mahony, T. D.; Wachholz, B. W. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

From Pacific Northwest Laboratory annual report for 1968 to the USAEC Division of Biology and Medicine. Vol. I. Life sciences. Pt. 1. Biological sciences.

The gastrointestinal radiation syndrome following lower-body exposure to 2500 R γ radiation followed a similar time course and dose response in the rat, guinea pig, and miniature swine. The onset of injury in the bowel, and of regeneration, was delayed in the rabbit. (auth)

34614 (BNWL-1050(Pt.1), pp 1.17-18) BETA IRRADIATION OF SWINE SKIN: AN EXPERIMENTAL DESIGN. Mahlum, D. D.; Amster, R. L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

From Pacific Northwest Laboratory annual report for 1968 to the USAEC Division of Biology and Medicine. Vol. I. Life sciences. Pt. 1. Biological sciences.

An experiment was initiated to systematically investigate the effect of dose and size of area irradiated on the response of swine skin to β radiation. Preliminary results indicate that both factors are important in the acute response. (auth)

34615 (BNWL-1050(Pt.1), pp 1.19-20) EFFECT OF ELECTROSTATIC CHARGING AND ELECTROSTATIC FIELDS ON SURVIVAL TIMES OF X-IRRADIATED MICE. Wehner, A. P. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

From Pacific Northwest Laboratory annual report for 1968 to the USAEC Division of Biology and Medicine. Vol. I. Life sciences. Pt. 1. Biological sciences.

Young, male, albino mice received a single, whole-body x ray exposure (700 to 825 R, 250 kV) while being kept for the duration

of the experiment on a metal plate maintained at either +2 or −2 kV. No significant effect of electrostatic charges and electrostatic fields on the survival times of the animals was observed. (auth)

34616 (BNWL-1050(Pt.1), pp 2.3-33) STRONTIUM-90 STUDIES IN MINIATURE SWINE. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

From Pacific Northwest Laboratory annual report for 1968 to the USAEC Division of Biology and Medicine. Vol. I. Life sciences. Pt. 1. Biological sciences.

Twelve reports in this section discuss various aspects of the continuing study of the biological effects of daily ^{90}Sr ingestion by miniature swine. Approximately 770 Pitman–Moore miniature swine, spanning three generations, have been fed daily doses of this radioisotope ranging from 1 to 3100 μCi/day, while 200 of their untreated littermates have served as controls. Currently, 150 experimental and 97 control swine are being maintained for lifetime observation and study. Thus far, 69 experimental and two control swine have developed myelolymphoproliferative disorders. The two cases observed in controls were found in 8- to 9-year-old animals diagnosed as having myelogenous leukemia. In addition, seven of the animals with hematopoietic disorders also exhibited bone tumors. The cumulative skeletal radiation doses in these swine ranged from 20 to 20,000 rad for those with myelolymphoproliferative disorders and from 9,000 to 15,000 rad for those showing bone tumors. The results of this chronic feeding experiment contrast with findings reported by other laboratories of a preponderance of bone neoplasms in experimental animals following single or multiple injections of ^{90}Sr at more mature ages. (auth)

34617 (BNWL-1050(Pt.1), pp 4.3-6) EFFECT OF AGE AND PHYSICOCHEMICAL FORM ON PLUTONIUM TOXICITY AND METABOLISM IN THE RAT. Mahlum, D. D.; Sikov, M. R. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

From Pacific Northwest Laboratory annual report for 1968 to the USAEC Division of Biology and Medicine. Vol. I. Life sciences. Pt. 1. Biological sciences.

Decreases in femoral breaking strength and changes in water and ash content of the femur appear to be dependent on radiation dose and on the maturity of the bone at time of ^{239}Pu administration. Hepatic parenchymal cell function, as evaluated by rose bengal clearance, was more affected by polymeric plutonium in the adult and by monomeric plutonium in weanling and newborn rats. An increased incidence of mammary tumors was observed in female rats injected as weanlings or adults, with doses of 6 or 12 μCi/kg, but not in rats which survived higher doses. (auth)

34618 (BNWL-1050(Pt.1), pp 4.7-11) AGE DEPENDENCE OF RADIOIODINE METABOLISM AND TOXICITY IN RATS. Sikov, M. R.; Mahlum, D. D. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

From Pacific Northwest Laboratory annual report for 1968 to the USAEC Division of Biology and Medicine. Vol. I. Life sciences. Pt. 1. Biological sciences.

The effect of radiation from injected ^{131}I on the morphology of the thyroid gland was dependent on the age of the rat at the time of administration. In adult animals, cellular necrosis and secondary repair occurred, while in perinatal animals there was an inhibition of tissue proliferation and maturation. Examination of effect in other organ and tissue systems indicated that some were a result of the whole-body radiation dose while others may be attributed to the resulting hypothyroid state of the animals. (auth)

34619 (BNWL-1050(Pt.1), pp 4.14-16) RADIOIODINE IN SHEEP AND SWINE. Palmer, R. F.; Beamer, J. L.; Karagianes, M. T. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

From Pacific Northwest Laboratory annual report for 1968 to the USAEC Division of Biology and Medicine. Vol. I. Life sciences. Pt. 1. Biological sciences.

Thyroids of miniature swine, fed 2 mCi ^{131}I two years previously, showed varying degrees of damage as indicated by ^{131}I uptake tests, protein-bound iodine values, and histopathologic examination. (auth)

34620 (LF-41, pp 1-7) TOXICITY OF INHALED $^{90}SrCl_2$ IN BEAGLE DOGS. Boecker, B. B.; Chiffelle, T. L.; Hobbs, C. H.; Jones, R. K.; McClellan, R. O.; Pickrell, J. A.; Redman, H. C. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.).

Studies on the metabolism, dosimetry, and effects of inhaled $^{90}SrCl_2$ in the beagle dog are continuing in an effort to provide a basis for assessing the consequences of inhaling ^{90}Sr such as might be released in certain nuclear accidents. Seventy-two dogs were exposed to aerosols containing ^{90}Sr, resulting in initial body burdens ranging from 2.6 to 280 μCi^{90}Sr/kg. Forty-eight of these dogs are being maintained for lifetime observation and have been placed in a longevity study consisting of four groups based on their retained ^{90}Sr burden at 14 days post-inhalation. Group means were 1.4, 6.2, 30, and 75 μCi^{90}Sr/kg. Twenty-four dogs with a 14-day retained ^{90}Sr burden of 31 μCi/kg have been assigned to a sacrifice study. Two of these dogs were sacrificed at 5 days, 2 at 1 month, and 2 at 1 year after inhalation of ^{90}Sr. To date, 21 dogs have died or were euthanized, 6 during the first 31 days after inhalation of ^{90}Sr with severe hematologic dyscrasia, and 15 between 585 and 1540 days after inhalation of ^{90}Sr. The latter group includes five with angiosarcomas, three with fibrosarcomas, four with osteosarcomas, 1 with osteochondrosarcoma, one with leukemia, one with an epileptic seizure, and one with cerebellar hemorrhage. (One dog had both an angiosarcoma and an osteosarcoma.) The skeleton of these dogs received initial radiation dose rates of 16 to 60 rad/day and cumulative doses to death of 7500 to 19000 rads. Serial observations are continuing on 49 surviving ^{90}Sr dogs and 22 control dogs. (auth)

34621 (LF-41, pp 8-14) TOXICITY OF INHALED $^{144}CeCl_3$ IN BEAGLE DOGS. Boecker, B. B.; Chiffelle, T. L.; Jones, R. K.; McClellan, R. O.; Pickrell, J. A.; Redman, H. C. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.).

Studies on the metabolism, dosimetry, and effects of inhaled $^{144}CeCl_3$ in the beagle dog are continuing in an effort to provide information that will aid in assessing the biological consequences of inhaling ^{144}Ce such as might be released in certain nuclear accidents. Studies on the tissue distribution of inhaled $^{144}CeCl_3$ indicate that ^{144}Ce deposited in the lung is translocated at a moderately rapid rate to liver and skeleton. The pattern of distribution is such that significant radiation doses are accumulated by all three tissues. Fifty-five dogs that inhaled $^{144}CeCl_3$ and 15 control dogs were placed in a longevity study and will be observed for their lifespan. These dogs were placed in six groups based on initial ^{144}Ce burden (group means 0, 14, 51, 130, 280, and 480 μCi/kg). These were regrouped on the basis of retained ^{144}Ce at 14 days post-inhalation to yield groups with mean ^{144}Ce content of 0, 5.2, 14, 40, 120, and 230 μCi/kg. Fifteen dogs from the two highest groups died; eight at 21 to 44 days post-inhalation with signs attributed to severe bone marrow damage and associated pancytopenia; two at 138 and 144 days with radiation pneumonitis; three at 309 to 874 days with hepatic necrosis; one at 510 days with marrow aplasia, and one at 375 days with pulmonary fibrosis. Serial observations are continuing on the 40 surviving ^{144}Ce dogs and 15 control dogs. (auth)

34622 (LF-41, pp 15-18) TOXICITY OF INHALED $^{91}YCl_3$ IN BEAGLE DOGS. Boecker, B. B.; Chiffelle, T. L.; Jones, R. K.; Kanapilly, G. M.; McClellan, R. O.; Pickrell, J. A.; Redman, H. C. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.).

Studies on the metabolism, dosimetry, and effects of $^{91}YCl_3$ in beagle dogs are continuing with a view to providing information that will assist in assessing the biological consequences of nuclear accidents in which ^{91}Y or other radionuclides that produce a similar radiation dose pattern may be released. Forty-two dogs with ^{91}Y burdens from 73 to 1330 μCi/kg were placed in four groups with mean initial body burdens of 120, 260, 560, and 920 μCi/kg. For comparison with observed biological effects, these same dogs were regrouped on the basis of retained 14-day body burdens yielding groups with mean values of 31, 59, 140, and 270 μCi/kg. These dogs and 12 control dogs are being maintained for lifetime observation. An additional four dogs with mean initial ^{91}Y burdens of 560 μCi/kg were placed in a sacrifice study. Eleven dogs within the highest exposure groups died or were euthanized at 17 to 33 days after inhalation of ^{91}Y with changes related to severe bone marrow damage and associated pancytopenia. Two dogs died approximately one year after ^{91}Y inhalation with convulsive seizures that were presumed to be unrelated to the ^{91}Y exposure. Thirty-five dogs that had initial lung burdens of 73 to 660 μCi/kg and all 12 control dogs are surviving at 800 days or more after inhalation of ^{91}Y. Serial observations are continuing on all surviving dogs. (auth)

34623 (LF-41, pp 19-35) TOXICITY OF INHALED ^{144}Ce FUSED CLAY IN BEAGLE DOGS. Boecker, B. B.; Chiffelle, T. L.; Clapper, W. E.; Jones, R. K.; Mauderly, J. L.; McClellan, R. O.; Pickrell, J. A.; Redman, H. C. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.).

The metabolism, dosimetry, and effects of inhaled ^{144}Ce in fused clay are being investigated in the beagle dog to aid in assessing the biological consequences of release of ^{144}Ce in a relatively insoluble form such as might occur in certain types of nuclear accidents. Further, the toxicity of inhaled ^{144}Ce fused clay is of broad interest since it may be considered as representative of a group of intermediate-lived, beta-emitting radionuclides. Two major studies are being performed: a metabolism and dosimetry study

in which 24 dogs are being serially sacrificed over an extended period of time, and a longevity study with two series of dogs; Series I with 15 dogs exposed to aerosols of ^{144}Ce in fused clay to yield initial lung burdens of 88 to 2100 μCi and 3 control dogs exposed to nonradioactive clay and Series II with 48 dogs exposed to date to aerosols of ^{144}Ce in fused clay to yield initial lung burdens of 0.10 to 580 μCi and 6 control dogs exposed to nonradioactive clay. The ^{144}Ce in fused clay is retained tenaciously in the lung with only small quantities being translocated to tracheobronchial lymph nodes, liver and skeleton, however, because of the small size of the tracheobronchial lymph nodes they exceed the lung in ^{144}Ce concentration by 100 days post-inhalation. To date, 9 of the 15 dogs in Series I have died or been euthanized at 143 to 410 days after inhalation of ^{144}Ce. The prominent finding is a severe pulmonary fibrosis. The cumulative radiation dose to the lung to time of death has ranged from 48,000 to 110,000 rads. The cumulative radiation dose to the lungs of survivors to 550 days post-inhalation range from 16,000 to 31,000 rads. All dogs in Series II are surviving at 60 to 154 days after inhalation of ^{144}Ce fused clay. The cumulative radiation dose to lung at 60 days ranges up to 15,000 rads. Serial observations are continuing on all survivors with special attention directed to evaluating ^{144}Ce metabolism and dosimetry, and various clinical, pulmonary function, hematologic, serum chemical, and microbiologic parameters. (auth)

34624 (LF-41, pp 36-45) TOXICITY OF INHALED $^{137}CsCl$ IN THE BEAGLE DOG. Boecker, B. B.; Redman, H. C.; Chiffelle, T. L.; Clapper, W. E.; Jones, R. K.; Lundgren, D. L.; McClellan, R. O.; Pickrell, J. A.; Rypka, E. W. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.).

Studies on the metabolism, dosimetry, and effects of intravenously administered $^{137}CsCl$ in the beagle dog are being conducted to aid in assessing the biological consequences of exposure to ^{137}Cs such as might occur in the event of certain nuclear accidents. The effects of the chronic, relatively uniform whole-body exposure produced by ^{137}Cs are being compared with other diverse radiation dose patterns resulting from inhalation of radioactive aerosols. Sixty-six dogs were entered into the study, six with a mean initial ^{137}Cs body burden of 3780 μCi/kg, and 12 dogs each with mean initial ^{137}Cs body burdens of 2820, 1940, 1420, 970, and 0 μCi/kg. All six of the highest level dogs died at 19 to 33 days post-injection having cumulative whole-body doses of 900 to 1300 rads. Four dogs at the 2820 μCi/kg level died 24 to 81 days post-injection having cumulative whole-body doses of 810 to 1300 rads. One dog in the 1940 μCi/kg level died at 77 days post-injection with a cumulative whole-body dose of 1300 rads. An early dose-related depression of lymphocytes, granulocytes, platelets, and packed cell volume was followed by a return of granulocytes and platelets to near normal by 196 days post-injection, whereas, lymphocyte and packed cell volumes are still depressed to a variable degree at 224 days post-injection. All non-survivors, and some survivors became febrile, anorexic, hemorrhagic, lethargic, dehydrated, and in some cases, developed diarrhea. Serial observations are continuing on all survivors. (auth)

34625 (LF-41, pp 46-58) TOXICITY OF INHALED ^{90}Y FUSED CLAY IN BEAGLE DOGS. Barnes, J. E.; Hobbs, C. H.; Chiffelle, T. L.; Jones, R. K.; Kanapilly, G. M.; Mauderly, J. L.; McClellan, R. O.; Pickrell, J. A. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.).

Studies on the metabolism, dosimetry, and effects of inhaled ^{90}Y in fused clay were initiated in the beagle dog to aid in assessing the biological consequences of inhalation of an energetic beta emitter that has a short effective half-life in the lung. ^{90}Y was ion exchanged into montmorillonite clay, aerosolized, fused into spherical particles at 1100°C, and delivered in aerosol form to beagle dogs. Six dogs were exposed to an aerosol with an activity median aerodynamic diameter of 1.4μ. The kinetics of deposition, clearance, and translocation were observed by whole-body counting, scanning, excreta analysis, and tissue activity analysis at death. Sixty-six percent of the inhaled activity was deposited in the body with 51% of the deposited ^{90}Y in lung. During the first two days after inhalation, essentially all of the non-lung ^{90}Y was cleared via fecal excretion. The calculated infinite radiation dose to lung was 1.2 rad/μCi ^{90}Y deposited in lung and for the colon 38 rad/mCi ^{90}Y deposited in the upper respiratory tract and cleared via the gastrointestinal tract. Sixteen dogs were exposed to an aerosol of ^{90}Y fused clay with a median aerodynamic diameter of 0.9μ. Forty percent of the inhaled activity was deposited in the body with 97% of the deposited ^{90}Y in lung. Two control dogs received nonradioactive clay. The resultant initial lung burdens (ILB) ranged 1 to 58 mCi ^{90}Y. Three dogs with ILB of 22 to 58 mCi died from 7.5 to 38 days post-inhalation with the most prominent clinical and pathological signs related to severe pulmonary edema, vascular necrosis, and early fibrosis. The cumulative dose to lung to death was 23,000 to 58,000 rads. A dog with an ILB of 17 mCi ^{90}Y and a cumulative dose to lung of 20,000 rads died during radiographic procedures on day 23. This dog had shown signs of radiation pneumonitis. An additional dog, with an ILB of 22 mCi ^{90}Y and cumulative dose to lung of 27,000 rads, showed clinical signs compatible with radiation pneumonitis. The remaining 11 dogs with ILB of 1 to 14 mCi of ^{90}Y and infinite doses to lung of 1900 to 31,000 rads are showing no major clinical abnormalities at 45 days and will be studied for the remainder of their lifespan. Additional dogs are being exposed to similar aerosols of ^{90}Y. Serial observations are continuing on all survivors. (auth)

34626 (LF-41, pp 192-202) CYTOGENETIC AND OTHER EFFECTS OF ^{144}Ce IN CHINESE HAMSTERS. Brooks, A. L.; Jones, R. K.; Hurni, W. M.; McClellan, R. O.; Sturbaum, Barbara (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.).

The tissue distribution and retention of ^{144}Ce was observed in four groups of hamsters that inhaled $^{144}CeCl_3$ or were given intraperitoneal injections of $^{144}CeCl_3$ or ^{144}Ce citrate. Following inhalation, the body burden decreased rapidly so that only 20% of the initial body burden remained after one week and, with time post-inhalation, the percentage of the sacrifice body burden in lung decreased and that in skeleton and liver increased. The injected ^{144}Ce was retained more tenaciously so that by one week postinjection 80% of the initial body burden remained and was almost totally localized in liver and skeleton. The ratio of ^{144}Ce in liver to ^{144}Ce in skeleton was nearly constant at about 3:1 in all animals. For the inhalation-exposed hamsters, the highest cumulative radiation dose to 256 days postinhalation was received by the lung, followed by liver, then skeleton; however, the infinite radiation doses to lung and liver were almost equal. Hamsters that received ^{144}Ce by injection had the highest infinite radiation dose to liver followed by skeleton. Groups of 12 hamsters were given intraperitoneal injections of 0, 0.15, 0.31, 0.62, 1.25, 2.5, and 5.0 μCi ^{144}Ce/gm and observed for 120 days. Median survival time at the three highest levels was 113, 48, and 19 days. Survivors at 120 days were partially hepatectomized, given colchicine, and killed for cytogenetic evaluation of the liver cells. Additional animals in groups of six were injected with 0, 0.15, 0.45, 0.90, and 1.8 μCi/gm and sacrificed in subgroups of two at 4, 13, and 40 days postinjection for light and electron microscopic studies. Although no discernible light microscopic alterations were evident, three distinct types of ultrastructural changes were noted: dilatation of the endoplasmic reticulum, a numerical increase in lysosomes, and a depletion of ribosomes. Additional animals were injected with 0, 0.002, 0.006, 0.017, 0.05, 0.15, and 0.45 μCi/gm body weight, partially hepatectomized two days prior to sacrifice and sacrificed in groups of six at 6, 15, 42, and 122 days after ^{144}Ce injection for cytogenetic evaluation. Analysis of metaphase liver chromosomes following partial hepatectomy indicated a linear increase in total breaks per cell with cumulative radiation dose. When compared to ^{60}Co studies, the coefficient of aberration production for isochromatid deletions was about one-fourth of that observed following a single exposure to ^{60}Co γ irradiation. Rings, dicentrics and obvious chromosome exchanges increased linearly relative to cumulative radiation dose through 10,000 rads exposure with the rate of increase of the abnormalities, which was lower than that found following ^{60}Co γ irradiation. This system is a sensitive technique for assessing radiation-induced effects at low radiation dose rates (300 rads accumulated over 120 days). (auth)

34627 (NYO-3359-10) ALTERATION OF TASTE THRESHOLDS IN THE RAT FOLLOWING LOW DOSE X-IRRADIATION. Shaber, Gary S. (Thomas Jefferson Univ., Philadelphia, Pa. Stein Research Center). [1970]. Contract AT(30-1)-3359. 35p. Dep. CFSTI.

The taste thresholds for saccharin (sweet), hydrochloric acid (sour), sodium chloride (salt), and quinine hydrochloride (bitter) were determined in 32 adult Wistar rats, eight rats for each taste material, before and after a 50 R, 250 kVcp x ray exposure to the tongue. All animals experienced a tenfold decrease in taste sensitivity within 24 hours following the x ray exposure and all threshold values returned to pre-irradiation levels within 72 hours. The speed of onset and duration of the transient alteration in taste thresholds was dependent upon the particular taste substance under investigation. A study of the rate of tritiated thymidine incorporation into the taste bud confirmed the 10-day average life span for a taste bud cell and indicates that the immediate low dose radiation effect on taste is independent of taste bud cell renewal kinetics. Morphological study of the taste buds failed to reveal an anatomical explanation for the observed radiation change in taste acuity. (auth)

34628 (NYO-3359-12) ALTERATION OF TASTE THRESHOLDS BY LOW DOSES OF IONIZING IRRADIATION. Progress

Report, May 1, 1969–May 1, 1970. Shaber, Gary S. (Thomas Jefferson Univ., Philadelphia, Pa. Stein Research Center). Contract AT(30-1)-3359. 9p. Dep. CFSTI.

The effects of doses of 25 or 50 R x radiation administered to the tongue of rats on taste sensitivity were studied. Changes in taste sensitivity for erythrose and saccharin were observed for periods up to 24 hr following direct tongue exposure. (C.H.)

34629 (RLO-2011-7) NUCLEO-CORTICAL INTERACTIONS IN AMPHIBIAN DEVELOPMENT. Annual Progress Report, August 1, 1969–April 30, 1970. Grant, Philip (Oregon Univ., Eugene). Contract AT(45-1)-2011. 10p. Dep. CFSTI.

This investigation was undertaken with the hypothesis that developmental information is stored in the grey crescent cortex of the amphibian egg, and is expressed indirectly via interaction with nuclei. It was assumed that cleavage segregates nuclei to specific regions of an organized cytoplasm (including cortex) and there, by virtue of mutual interactions, activates the genome for morphogenetic expression. Investigations over these past few years have not provided any direct support for this hypothesis. Specific uv-induced cortical lesions have profound developmental effects; they prevent normal gastrulation, embryo axis formation, and neurulation; they effectively eliminate the organizing properties of the grey crescent area. The nuclear transplantation experiments, albeit incomplete, imply that irreversible interactions between nucleus and the so-called cortical information do not occur, and may not be an important mode of interaction in this embryo. The experiments are now best interpreted by assuming the cortex does not contain information in the sense of template molecules or programmed ribosomes but rather, its developmental role is an expression of intrinsic properties of the cortex and or plasma membrane such as permeability, adhesiveness, elasticity, contractility, all vital in morphogenetic movements and cellular interactions. UV irradiation, in this case, would not destroy any informational sites but would modify anyone or all of these properties either by changing cell membrane structure or by disturbing some underlying cortical organelle like a microfilament or microtubule subunit, both essential in cell motile phenomena as well as shape changes. If this interpretation is correct, then it is unlikely that cortical lesions would have any permanent effect on the genetic behavior of nuclei. The effects may only be transitory, easily reversible by implantation in normal cytoplasm. (auth)

34630 (UCB-34-P-82-X-1) EFFECTS OF X RADIATION ON CENTRAL NERVOUS SYSTEM MATURATION. Progress Report, August 1, 1968–July 31, 1969. (California Univ., Berkeley). Contract AT(11-1)-34. 38p. Dep. CFSTI.

Effects of x radiation on choline acetyltransferase activity in various areas of the rat central nervous system were investigated. Following 500 R whole-body exposure of two-day old rats, control and experimental animals were killed at 9, 23, and 61 days of age and various parts of the brain and spinal cord were removed and prepared for analysis of enzyme activity. The activity of choline acetyltransferase increased with age in the cerebral cortex, spinal cord, and hypothalamus of all animals with no differences between control and x-irradiated rats. However, in the cerebellum, enzyme activity was markedly higher at 9 days and at 61 days of age. The DNA content of the cerebellum was decreased by irradiation. Enzyme activity and DNA changes in the cerebellum are related to the radiosensitivity of the various cell layers. For studies on myelinogenesis, chickens were exposed to 1600 R γ radiation at 24 days after hatching. Total sphingolipid content was found to be lower in irradiated than in control animals; this was interpreted as a selected decrease in sphingomyelin. For studies on the interrelation between anticonvulsant drugs and x radiation, dilantin(diphenylhydantoin) and barbital were used. Rats were exposed to 500 R whole-body doses; dilantin was injected into one half of the irradiated rats and NaCl was injected into the remaining rats. Unirradiated rats were also injected with dilantin and NaCl. In x-irradiated rats the electroshock seizure threshold was elevated at 9 days of age, but reduced at 23 and 32 days. The threshold of control rats injected with dilantin at 11 days was elevated, but lower in x-irradiated rats. Studies on the effects of x radiation on the response of developing rats to hypnotic doses of barbital showed a lower incidence of hypnotic response in x-irradiated rats than in controls. Preliminary experiments on the effects of x radiation on the free amino acid content of various brain regions indicated that all areas of the brain did not respond uniformly to x radiation. Studies on effects of x radiation on ^{14}C-uridine incorporation into RNA in neural tissue maintained as organ cultures showed that at all dose levels x radiation markedly decreased the incorporation of ^{14}C-uridine into RNA. Results indicated that alterations in RNA synthesis may be one of the primary biochemical changes following x radiation of the central nervous system. Techniques were developed for long-term culturing of cerebellar tissue in preparation for future studies on the effects of x radiation on morphological and functional growth of neuronal and glial elements in vitro. Studies on the effects of aging on choline acetyltransferase activity in the central nervous system of rats showed that the enzyme activity was lower in the spinal cord of older rats than in young rats. It was found that neonatal hypothyroidism decreased the activity of choline acetyltransferase in the cerebral cortex and to a lesser extent in the hypothalamus and had no effect on the spinal cord. (H.L.W.)

34631 MODIFICATION OF GROWTH KINETICS OF COLONY-FORMING UNITS IN VIVO. Lahiri, S. K.; Van Putten, L. M. (Radiobiological Inst. TNO, Rijswijk Z. H., Netherlands). pp 107-16 of Radiation-Induced Cancer. Vienna; International Atomic Energy Agency (1969).

From Symposium on Radiation-Induced Cancer, Athens, Greece. See STI/PUB-228; CONF-690404.

The observation of hemopoietic colonies in the spleens of heavily irradiated recipient mice after intravenous injection of hemopoietic cells led to a technique for assay of hemopoietic progenitor cells in a tissue. If the recipient's spleen is taken out shortly after injection and its cells are intravenously retransplanted into secondary recipients, the number of colonies observed in the secondary recipient's spleen gives an idea of the fraction of primarily injected colony-forming units (CFUs) lodging and proliferating in the primary recipient's spleen. It is generally believed that the fraction recovered two hours after injection, the so-called f factor, is of importance because these CFUs are responsible for the colonies observed later. A detailed study of the growth kinetics of the injected CFUs in the spleen and femur of irradiated recipients showed that the recoverable fraction of injected CFUs decreased between two hours and one day after injection, and later showed an exponential growth pattern. This early dip in the growth curve was the subject of further study. It has been found that pretreatment of the donor and/or the recipient may change the dip in the growth curve of CFUs lodging in the spleen of the recipients. It is suggested that this dip is associated with differentiation of stem cells and that conditions may be produced where the hemopoietic progenitor cells can be induced to start proliferating immediately whereas their early differentiation, which is associated with loss of colony-forming ability, can be at least partially blocked. An analysis of the factors that cause such changes in the kinetics of transplanted CFUs may be useful in elucidating the conditions which contribute to the occurrence of leukemia in irradiated mice. (auth)

34632 GROWTH PATTERN OF FOLLICLES IN MICE AFTER X-RAY OR DMBA INDUCTION OF OVARIAN TUMOURS. Pedersen, T.; Krarup, T.; Peters, H.; Faber, M. (Finsen Inst., Copenhagen). pp 117-33 of Radiation-Induced Cancer. Vienna; International Atomic Energy Agency (1969).

From Symposium on Radiation-Induced Cancer, Athens, Greece. See STI/PUB-228; CONF-690404.

Whole-body x radiation of mice as well as treatment with the carcinogenic hydrocarbon 9:10-dimethyl-1:2 benzanthracene results in the formation of ovarian tumors. After both experimental procedures an immediate destruction of the small oocytes is initiated. Tumors arise in ovaries totally depleted of oocytes. The question arises how the two carcinogenic stumuli, besides destroying small oocytes, will influence the only cell population in the ovary that proliferates, namely granulosa cells in medium and large follicles. This was investigated by autoradiographs prepared at different time intervals after intraperitoneal injection of ^{3}H-thymidine. Two parameters were determined in the autoradiographs, i.e., the labeling index of the granulosa cells and the duration of the DNA synthesis phase. From these parameters the doubling times of the granulosa cells and the growth rate of whole follicles were calculated. It was shown that immediately after x-irradiation and after treatment with DMBA, the labeling index of the granulosa cells increases, which is most marked in the medium follicles. This increase reaches a maximum about 48 hours after both types of treatment and is still recognizable 7 days later. The duration of the S-phase of the individual cells is not significantly affected after DMBA treatment, but in x-irradiated animals it is shortened in the medium follicles 48 hours after irradiation. Simultaneously with the increase in the labeling index there is a shortening of the doubling times of the granular cells and thereby an acceleration of the growth rate of whole follicles. It seems most likely that the increase in labeling index is partly caused by an increase in the growth fraction of the granulosa cells and partly to a shortening of the generation time of the proliferating cells. (auth)

34633 RADIATION CARCINOGENESIS AND THE SIGNIFICANCE OF SOME PHYSICAL FACTORS. Faber, M. (Finsen Inst., Copenhagen). pp 149-59 of Radiation-Induced Cancer. Vienna; International Atomic Energy Agency (1969).

From Symposium on Radiation-Induced Cancer, Athens, Greece. See STI/PUB-228; CONF-690404.

A review of the literature on radiation carcinogenesis is presented. The dose-effect curve is described in detail and the implications are stressed. The incidence of radioinduced cancer is discussed with regard to myeloid leukemia in mice following whole-body x irradiation, skin cancer in rats after electron radiation, and x-radioinduced kidney cancer. The significance of DNA molecules and mitochondria in cellular target problems is discussed. Radioinduced cell killing in relation to RBE and LET is reviewed. Induction of tumors by ^{144}Ce, ^{131}I, Ra, Thorotrast, and tritiated thymidine is discussed. (H.L.W.)

34634 RELATIONSHIP OF DOSE OF TOTAL-BODY ^{60}Co RADIATION TO INCIDENCE OF MAMMARY NEOPLASIA IN FEMALE RATS. Shellabarger, C. J.; Bond, V. P.; Cronkite, E. P.; Aponte, G. E. (Brookhaven National Lab., Upton, N. Y.). pp 161-72 of Radiation-Induced Cancer. Vienna; International Atomic Energy Agency (1969). (BNL-13528).

From Symposium on Radiation-Induced Cancer, Athens, Greece See STI/PUB-228; CONF-690404.

Female Sprague–Dawley rats were exposed on the 40th day of age to a single dose of whole-body ^{60}Co gamma radiation. All animals were studied for the presence of mammary neoplasia for a 360-day period, by removing surgically each mammary tumor and subjecting each to histological examination. The overall survival rate was 96% and was not less than 94% in any group. Three of 75 control, non-exposed rats developed a total of three mammary neoplasms. Three of 54 rats exposed to 15.6 R developed four mammary neoplasms. Three of 54 rats exposed to 31.2 R developed five mammary neoplasms. Nine of 54 rats exposed to 62.5 R developed 13 mammary neoplasms. Eighteen of 54 rats exposed to 125 R developed 23 mammary neoplasms. Thirty-two of 54 rats exposed to 250 R developed 54 mammary neoplasms. Forty of 54 rats exposed to 500 R developed 105 mammary neoplasms. It appears that both the per cent of rats with mammary neoplasia and the total number of mammary neoplasms increase in a reasonably regular manner with increasing dose, when studied for one year post-exposure. These findings are in agreement with a previous report from this laboratory. (auth)

34635 DOSE-DEPENDENT CARCINOGENIC EFFECT OF RADIOSTRONTIUM. Nilsson, A. (Research Inst. of National Defence, Sundbyberg, Sweden). pp 173-82 of Radiation-Induced Cancer. Vienna; International Atomic Energy Agency (1969).

From Symposium on Radiation-Induced Cancer, Athens, Greece. See STI/PUB-228; CONF-690404.

Four groups of mature CBA male mice were treated intraperitoneally with $^{90}Sr(NO_3)_2$ at dose levels of 1.6, 0.8, 0.4 and 0.2 μCi ^{90}Sr/g body weight. Five mice from each group were killed at intervals of 7, 14, 21, and 30 days after injection of ^{90}Sr, and then at monthly intervals. Blood samples were taken and roentgenologic examination was made before the mice were killed. The heads and selected bones were fixed for histologic examination and the tumors were recorded. Tumors of the bones were found in all dose groups, the largest number in the 0.8-μCi level. In the highest dose group osteoblastic osteosarcomas predominated, but with decreasing dose the frequency of fibroblastic osteosarcomas increased. However, the highest incidence of carcinomas was found in the 1.6-μCi group. Most tumors of the head were located in the hard palate. The highest incidence of leukemia appeared in the 0.4-μCi group and the lowest in the 1.6 group. The latency time for carcinomas and osteosarcomas seems to be a function of dose, but this relationship does not seem to be true for ^{90}Sr-induced leukemias. (auth)

34636 RADIATION-ETHIONINE CARCINOGENESIS. Telles, N. C.; Ward, B. C.; Willensky, E. A.; Jessup, G. L. (Public Health Service, Rockville, Md.). pp 233-45 of Radiation-Induced Cancer. Vienna; International Atomic Energy Agency (1969).

From Symposium on Radiation-Induced Cancer, Athens, Greece. See STI/PUB-228; CONF-690404.

Rats were divided into the following groups of approximately 100 animals each: two control groups; two groups given whole-body x-ray (200 and 400 rads); two groups given ethionine; and two groups given radiation-plus-ethionine. Ethionine was placed in the diet at a concentration of 0.75 per cent by weight. The radiation groups were exposed two weeks before being placed on the ethionine diet. Ten rats from each group were sacrificed at 6-week intervals. After 54 weeks a total of 57 tumors had been observed in the rats receiving radiation-plus-ethionine, while only 17 liver tumors were found in the rats which received ethionine only. Of the rats receiving ethionine and 400 R, 38 developed liver tumors while 19 tumors were seen in rats given ethionine and 200 R. No liver tumors were found in control rats or in rats given radiation only. Statistical evaluation of the data showed that radiation did not accelerate the rate of development of liver tumors but acted by decreasing the latent period of tumor appearance. Also, the latent period was shorter in the rats receiving 400 R plus ethionine than in those receiving 200 R and ethionine. The tryptophan pyrrolase studies indicated that the levels in the liver were not altered at any time during the study once the animals were placed on ethionine. The hepatomas had low basal enzyme levels and almost no inducible enzyme, while adjacent liver tissue had normal enzyme levels and responded to hydrocortisone induction. (auth)

34637 HEREDITARY FACTORS INVOLVED IN RADIATION-INDUCED LEUKAEMOGENESIS. Duplan, J. F. (Institut du Radium, Paris). pp 265-75 of Radiation-Induced Cancer. Vienna; International Atomic Energy Agency (1969). (In French).

From Symposium on Radiation-Induced Cancer, Athens, Greece. See STI/PUB-228; CONF-690404.

The hereditary factors involved in radiation-induced leukemogenesis were studied in pure AKR and C57BL strains, their first-generation hybrids and their back-crosses. It is known that the heredity of spontaneous lymphoid leukemias is attributable to hereditary factors, of which only some are chromosomal, and the same situation can be considered to exist as regards the heredity of radiation-induced leukoses. In order to identify the various chromosomal and non-chromosomal factors concerned, three types of experiment were conducted with the pure strains and with each of the crosses, intended to evaluate (a) the incidence of spontaneous lymphoid leukoses, (b) the incidence of radiation-induced leukoses and (c) the inhibition of radioleukemogenesis by the injection of isogenic hematopoietic cells. The results show that the main non-chromosomal factor is the leukemogenic Gross virus (VG) in the case of the AKR strain and the radioleukemia virus (VRL) in that of the C57BL strain; these two agents are transmitted by the mother to her progeny. The VG may be responsible for radioleukemias as well as for spontaneous leukoses, but the VRL does not produce spontaneous leukemias even in back-crosses possessing a substantial fraction of the AKR genome, which is particularly conducive to leukemogenesis. Restoration using C57BL bone marrow brings about a distinct inhibition of leukemogenesis in all animals deriving from crossings for which this material is histocompatible; AKR marrow, however, never exhibits any restorative activity. Three hypotheses may be put forward to explain these results. The first is that C57BL bone marrow contains many more precursor elements than AKR marrow, these cells being necessary for inhibition of the leukemogenic process. The second hypothesis is that the AKR strain lacks a factor which is essential for the utilization of these precursors. Finally the third hypothesis, which seems the least probable, is that AKR cells are much more sensitive than C57BL cells to the leukemogenic virus. (auth)

34638 INDUCTION OF TUMORS AND LEUKAEMIA BY SPLIT DOSES OF X-RAYS. Metalli, P.; Silini, G.; Casillo, S.; Covelli, V. (CNEN, Rome). pp 277-88 of Radiation-Induced Cancer. Vienna; International Atomic Energy Agency (1969).

From Symposium on Radiation-Induced Cancer, Athens, Greece. See STI/PUB-228; CONF-690404.

To test for the effect of early recuperation phenomena on delayed radiation effects a split-dose technique (150 + 350 rads of 240 kVcp x rays) was applied with fractionation times of 4, 8, 12, 18, 24, 36, 48 hours to 544 young adult male mice of the C3H strain. The results provide evidence that recuperative events take place between 4 and 8 hours after the first dose of radiation. As a function of increasing the fractionation intervals, survival times also increase. Postmortem examinations were performed on all animals shortly after death, and a careful examination was carried out later on the formaldehyde-fixed carcasses; the final diagnoses were made only on macroscopic evidence. Suspected cases were not included in the final incidence estimates. A single dose of 500 rads of x rays resulted in approximately twice as many tumors as were found in the control group; the split-dose groups showed a lower incidence of all kinds of tumors. The results for leukemia were similar to those for tumors. When differences were far less pronounced these were restricted to the rats that were irradiated with the shortest fractionation times. Thymic lymphomas were found only in animals irradiated with fractionated doses, and the incidence was low. It is concluded that split doses of sublethal irradiation with short fractionation intervals are less efficient inducers of tumors and leukemia, and less efficient in life-span shortening. (auth)

34639 SPONTANEOUS AND STIMULATED LEUKAEMOGENESIS IN MICE OF THE AKR STRAIN WITH 38 OR 40

CHROMOSOMES. Leonard, A.; Deknudt, Gh. (Centre d'Etude de l'Energie Nucleaire, Mol, Belg.). pp 305-22 of Radiation-Induced Cancer. Vienna; International Atomic Energy Agency (1969). (In French).

From Symposium on Radiation-Induced Cancer, Athens, Greece. See STI/PUB-228; CONF-690404.

The part played by chromosome anomalies was studied in the development of spontaneous leukemias or leukemias stimulated by exposure to ionizing radiations, as observed in mice of the AKR strain. Mice of this strain normally have 40 chromosomes. A substrain which only has 38 chromosomes (AKR/T1 Ald) due to centromeric fusion of two acrocentric chromosomes was isolated. The possible effect of this chromosome change has been studied by comparing, in the two cases, the incidence of lymphoid leukemias and their period of latency in irradiated and non-irradiated individuals. To stimulate leukemogenesis the authors adopted the technique of Professor Duplan in which a whole-body dose of 175 R was administered to 30-day-old mice four times at seven-day intervals. The leukemia diagnosis was established by dissection carried out immediately after death, and in doubtful cases by a histological study. The results obtained are discussed in relation to the theories on the role of chromosome anomalies in carcinogenesis. (H.L.W.)

34640 INFLUENCE OF MOUSE AGE ON BONE-TUMOR FREQUENCY FROM INGESTED ^{90}Sr. Van Putten, L. M. (Radiobiological Inst. TNO, Rijswijk Z. H., Netherlands). pp 337-44 of Radiation-Induced Cancer. Vienna; International Atomic Energy Agency (1969).

From Symposium on Radiation-Induced Cancer, Athens, Greece. See STI/PUB-228; CONF-690404.

Groups of mice of different ages (3 to 20 weeks) received strontium-90 in their food for a period of 1 week. A wide variation in body burden resulted from feeding the nuclide at two different concentrations in the food to each age group. The strontium-90 body burdens were determined repeatedly by whole-body counting of the bremsstrahlung, and the mice were observed till death. Gross autopsies were performed on all animals and radiographs were made of the stripped skeleton to permit an estimate of the number of bone tumors. Dose-effect relationships were calculated from an evaluation of the bone-tumor frequency and the life span of mice with different body burdens. The strontium-90 injection dose, which produced a similar late retention curve in 10-week-old mice as was observed in the mice fed the nuclide, was estimated from earlier studies. This permitted a comparison of the dose-effect relationships observed after feeding strontium-90 at different ages with the dose-effect relationship after injection of strontium-90 at the age of 10 weeks, as studied earlier. The results imply that the main factor responsible for variation in strontium toxicity at different ages is the variation in strontium retention. For comparable body burdens of strontium-90 there is, within the accuracy of the experiments, no difference in life span or bone tumor frequency. The life span of these mice after administration of strontium-90 is determined by their tumor incidence (more than 90% of the mice die with one or more tumors). This implies that the frequency of other tumors than bone tumors is also unaffected by the age at which the internal irradiation started. Thus, it appears that under the conditions of these studies the tissue sensitivity to the carcinogenic effects of internal irradiation does not change significantly with the age of the animal. (auth)

34641 RADIATION-INDUCED NEOPLASMS IN BEAGLES AFTER ADMINISTRATIONS OF ^{90}Sr AND ^{226}Ra. Goldman, M.; Dungworth, D. L.; Bulgin, M. S.; Rosenblatt, L. S.; Richards, W. P. C.; Bustad, L. K. (Univ. of California, Davis). pp 345-60 of Radiation-Induced Cancer. Vienna; International Atomic Energy Agency (1969). (UCD-472-240).

From Symposium on Radiation-Induced Cancer, Athens, Greece. See STI/PUB-228; CONF-690404.

The comparative carcinogenic efficiency of two bone-seeking radionuclides is under study in a colony of several hundred beagles. The toxicity of internally deposited alpha emitters (^{226}Ra and its daughters) and of beta irradiation (^{90}Sr) at comparable dosage rates indicates marked differences in site of appearance and mode of action in litters studied up to 7 years of age. Radiation carcinogenesis in beagles exposed to ^{90}Sr daily from midgestation to adulthood (1.5 yr) is at present confined to dogs fed 4 μCi ^{90}Sr/d or higher. The 20 cases constitute a spectrum of myeloproliferative disorders characterized by terminal anemias, and ranging from myeloid metaplasia to granulocytic leukemia. Continuous high-level ^{90}Sr irradiation to bone and marrow from early life onward causes a thickened hypocellular bone (pachyostosis), some instances of myelofibrosis, and persistent mild leukopenia on which the final spectrum of terminal disorders is superimposed. In contrast, up to 100 μCi ^{226}Ra given intravenously (8 equally spaced injections at 14 to 18 months of age) to young adults is not a potent marrow cell carcinogen. The higher LET, shorter-range alpha particles are efficient in inducing bone cancers (14 cases) and skeletal lesions similar to those documented in watch-dial luminizers exposed to ^{226}Ra in the early 1900's. The incidence of hematopoietic and skeletal neoplasms observed is dose-rate related, and the morphologic characteristics have several analogues in human cancer. The use of identically treated litters rather than individuals affords additional opportunity to study possible familial factors in the distribution of the neoplasms. Pathogenic evaluation at this juncture strongly indicates that continued bone and marrow irradiation in early life is more likely to induce hematopoietic neoplasms than is skeletal irradiation starting in young adulthood, which induces osseous neoplasms. (auth)

34642 TUMOR INDUCTION IN RAT SKIN BY 300-kV X-RAYS AND 15-MeV NEUTRONS. Barendsen, G. W. (Radiobiological Inst. TNO, Rijswijk Z. H., Netherlands). pp 413-24 of Radiation-Induced Cancer. Vienna; International Atomic Energy Agency (1969).

From Symposium on Radiation-Induced Cancer, Athens, Greece. See STI/PUB-228; CONF-690404.

A transplantation technique was developed to study the carcinogenic action of fast neutrons and x rays on rat skin without interference from damage produced by the same radiations in underlying tissues, blood vessels, and regulating systems, including immunological defenses, of the organism. After whole-body irradiation of inbred white WAG/Rij rats, circular pieces of skin (about 20 mm in diameter) were cut from the backs of the rats. These pieces of skin were transplanted onto the backs of unirradiated brown (WAG/Rij × BN/Bi)F_1 hybrid rats in which a graft bed was prepared by excision of similar pieces of skin. The difference in color easily distinguished the grafted skin from the host skin. Immunological complications are avoided by this choice of graft and host. During the first 14 days after transplantation little difference is observed macroscopically and microscopically between unirradiated skin and skin grafts irradiated with doses of up to 3000 rads of x rays and 1500 rads of neutrons with respect to healing the graft. After about 14 days the irradiated skin grafts start to decrease in size. After about 8 weeks the ratios of remaining areas of grafted skins relative to controls approach constant values. The skin areas are left in place until the end of the life span of the host. They can subsequently be transplanted onto new hosts and studied for time intervals that exceed the life span of the hosts. Tumors were observed only at doses that are so large that only few epithelial cells would be expected to retain the capacity for unlimited proliferation. The tumors that occurred were transplanted in WAG/Rij rats, BN/Bi rats and in F_1 hybrids. The tumors grew only in WAG/Rij rats and F_1 hybrids, which shows that the basal cell carcinomas observed originated from the cells of the transplanted pieces of skin. The relation of the probability of malignant transformation and loss of cell reproductive integrity is discussed quantitatively. (auth)

34643 QUANTITATIVE EXPERIMENTAL STUDY OF LOW-LEVEL RADIATION CARCINOGENESIS. Upton, A. C.; Allen, R. C.; Brown, R. C. (and others) (Oak Ridge National Lab., Tenn.). pp 425-38 of Radiation-Induced Cancer. Vienna; International Atomic Energy Agency (1969).

From Symposium on Radiation-Induced Cancer, Athens, Greece. See STI/PUB-228; CONF-690404.

The purpose of this study is to determine the dose-response relation for carcinogenesis by low-level whole-body irradiation. Mice of the RFM strain were chosen for this investigation because they have been found to have a high degree of susceptibility to induction of leukemia and other neoplasms on exposure to less than 100 rems whole-body radiation and because they can be feasibly obtained in the large numbers needed for quantitative results at the dose levels of interest. To minimize variables other than radiation, including the danger of an epizootic, a colony of mice derived from germ-free ancestors and exposed to a selected group of bacteria is being maintained under rigorously controlled environmental conditions. To date, more than 8000 such mice have been exposed to 10 to 400 rads of whole-body ^{137}Cs gamma rays, with a larger number still to be irradiated in weekly replicates over the next 1 to 2 years. Interim results reveal a dose-dependent increase in the incidence of neoplasms (chiefly leukemia) and a decrease in the life span, down to the lowest dose tested; namely, 10 rads. Results at the latter dose are still fragmentary, however, and hence will require far larger numbers of animals for verification. These and other preliminary results, their interpretation, and pertinent details of the design and methodology of the experiment, are discussed. (auth)

34644 COMPARATIVE STUDY OF EXPERIMENTALLY INDUCED CANCER OF THE KIDNEY IN MICE AND RATS WITH X-RAYS. Maldague, P. (Univ., Louvain, Belg.). pp 439-58 of Radiation-Induced Cancer. Vienna; International Atomic Energy Agency (1969).

From Symposium on Radiation-Induced Cancer, Athens, Greece. See STI/PUB-228; CONF-690404.

Local irradiation of a kidney in rats and mice results in the development of radiation-induced cancers in the irradiated kidney. The production of these cancers is considerably greater in rats than in mice, and their frequency depends on: the x-ray dose absorbed by the kidney; the latency period which is longer for carcinomas than for sarcomas; and the degree and extent of renal radiation-induced lesions. A study of the relationship between dose and carcinogenic effect has enabled us to define three types of x-ray dose: an ineffective dose of 570 rads at which the inducement of cancer is zero; an optimum dose of 1,700 rads at which the frequency of renal tumors is maximal (85%); and excessive doses between 7,000 and 14,000 rads after which the frequency of radiation-induced cancers of the kidney approaches zero. Studies of the latent period have shown that radiation-induced cancers of the kidney in mice do not appear until 790 days after irradiation, whereas in rats the first cancers appear after 280 days. As regards the mechanism of the inducement of renal cancer by radiation, we have been able to establish that cancers of the kidney only develop from visible renal lesions. Radiation-induced cancers have not been observed in rats or mice whose kidneys were morphologically and functionally normal. (auth)

34645 SOME REMARKS ON RADIATION-INDUCED CARCINOGENESIS. Kuenkel, H. A. (Institut fuer Strahlenbiologie, Hamburg). pp 471-8 of Radiation-Induced Cancer. Vienna; International Atomic Energy Agency (1969).

From Symposium on Radiation-Induced Cancer, Athens, Greece. See STI/PUB-228; CONF-690404.

A discussion is presented of previously reported investigations on experimental tumor induction. Emphasis is placed on dose-effect relationships. A study conducted by WHO on leukemia in patients who received therapeutic irradiation for cervical cancer is discussed. Studies on induction of leukemia in animals and humans by ionizing radiation indicated that the frequency of leukemia was a linear function of dose. Other topics discussed are: induction of tumors by incorporated radioactive substances; the relation between radiosensitivity and rate of proliferation of tumor cells; and radioinduced processes at the molecular and cellular levels. (H.L.W.)

34646 EFFECTS OF X RAYS ON SULFHYDRYL GROUPS IN NORMAL HUMAN SKIN. Csermely, E.; De Panfilis, G.; Santini, R. (Univ., Parma, Italy). G. Ital. Dermatol.; 109: 175-8 (May-Jun 1968). (In Italian).

The effects on -SH groups produced by x-ray doses ranging from 100 to 1000 R were studied in healthy skin. Both male and female subjects aged 57 to 78 yr were treated with 29-kV radiation from a Dermopan apparatus. Skin biopsies were examined 12, 24 hr, 4, 8, and 15 days postirradiation. Frozen sections were stained by the method of Chevremont and Frederic for -SH groups. The reaction for -SH groups observed in the irradiated skin was found to be no different from that observed in nonirradiated skin, and to be independent of the dose of radiation delivered and the time interval between irradiation and biopsy. It is concluded that the lack of any changes in -SH groups is attributable to the low doses used, which were much lower than those utilized by other investigators who have, in contrast, observed a reduction in the content of -SH groups in irradiated skin. Previous doses used ranged from 1500 to 7000 R. (BBB)

34647 THE EFFECT OF DIMETHYL SULFOXIDE (DMSO) ON THE RADIOSENSITIVITY OF THE ROUGH SKINNED NEWT (TARICHA GRANULOSA). Lappenbusch, William Louis. Corvallis, Oreg.; Oregon State Univ. (1969). 132p.

Thesis.

More than 2,000 male newts were collected during the summer and maintained unfed at 10°C both pre- and post-irradiation. Exposures ranging up to 30 kR were given with 300 kVp x rays and ^{60}Co γ rays. Half of the newts were injected (I.P.) with 15 g DMSO/kg (the maximum sublethal dose) just before exposure. The remainder were irradiated without treatment. The mean survival time-exposure curves for both groups of animals were typically sigmoid. However, the mean survival times of the DMSO-treated newts were significantly longer for all exposures between 200 R and 15 kR. The threshold lethal dose for the untreated newts was 200 R, while at exposures up to 600 R the DMSO-treated animals showed a mean survival time not significantly different from the fasting controls (370 days). A dose-reduction factor of 2.45 was calculated for the time presumed to represent the predominant phase of the hematopoietic syndrome (200 days). Additional studies revealed a linear relation between the concentration of DMSO administered, and the degree of radioprotection afforded and demonstrated clearly that DMSO must be administered prior to irradiation to be protective. Marked changes in the physiological status of the DMSO-treated newts were observed that may partially account for their reduced radiosensitivity. DMSO-treated newts showed a decreased metabolic rate during the early post-injection period. Their red blood cell count underwent a dramatic increase, while untreated newts displayed the typical post-irradiation anemia. DMSO also appeared to prevent the visible skin ulcerations following irradiation commonly observed in the non-treated newts. (Disser. Abstr.)

34648 REACTIVE CHANGES IN THE CENTRAL NERVOUS SYSTEM AND ENDOCRINE ORGANS IN BURN IRRADIATION LESIONS. Pilipenko, N. I. (Kharkov State Medical Inst.). Byull. Eksp. Biol. Med.; 63: No. 4, 48-52 (Apr 1967). (In Russian).

With the aid of vital stains, alterative changes in the regulation organ tissues after burn irradiation lesions were studied. It was found that the depth of alteration in the large hemispheres, the cerebellum, medulla oblongata, hypophysis, adrenals, thyroid, and pancreatic glands was greater after combined burn and irradiation lesions as a rule than when these factors act independently (thermal burn or general irradiation). It is suggested that increased upset of the controlling organs may be one of the causes of deterioration of general condition of irradiated animals after addition of a thermal burn. (auth)

34649 THE EFFECT OF ^{60}Co IRRADIATION ON THE PATELLA IN DOGS. Rokkanen, Pentti; Rissanen, Pentti; Paatsama, Saki (Univ. Central Hospital, Helsinki. Coll. Veterinary Medicine, Helsinki). Acta Orthop. Scand.; 40: 563-70 (1969).

The effect of ^{60}Co irradiation on the patella in dogs was studied by histological, histochemical, and oxytetracycline-labeling techniques and by microradiography. Single doses of 1000, 2000, and 4000 Rad were used. The dogs were sacrificed four days, two weeks, and two months after irradiation. After four days both growing dogs and adult dogs showed fragmentation and decreased metachromasia of the articular cartilage as well as degenerative changes of the bone, but signs of regeneration were also observed. After two weeks, and again after two months, both the degenerative and the regenerative changes were more marked. On comparing the changes observed with the changes caused by the same doses in cancellous and diaphyseal bone, the changes in the patella were found to be more extensive and severe. (auth)

34650 EFFECT OF BETA RADIATION ON MESENTERIC PACINIAN CORPUSCLE RESPONSE. Talbott, Richard E. (Naval Radiological Defense Lab., San Francisco). Radiat. Res.; 42: 539-51 (Jun 1970).

Responses of 26 cat mesenteric Pacinian corpuscles, recorded in situ, were used to characterize the effect of low dose beta radiation on these visceral receptors. Control experiments were performed on 14 of these receptors while the remaining 12 receptors were exposed to a ^{90}Sr-^{90}Y beta source for varying lengths of time. Experimental conditions were such that the Pacinian corpuscles responded repetitively to 2-msecond mechanical pulses and produced trains of spikes during sustained deformation of the tightly stretched mesenteric sheet. The receptors were not active in the absence of an imposed stimulus and, in agreement with other reports, none of the irradiated receptors showed any activity attributable to the presence of radiation alone. For irradiated corpuscles the variation in spacing between adjacent clusters on poststimulus time histograms, derived from a repeated series of mechanical pulses, appeared to reflect a specific alteration of the normally stationary distribution of evoked responses. The most prominent effect of low dose irradiation was the alteration of the preferred interspike interval during trains of spikes elicited by constant deformation. In most cases, irradiation of the Pacinian corpuscle led to a shortened preferred interval while in one case the interval was selectively lengthened. The range of preferred intervals corresponded with the frequency of the lowest threshold vibratory stimulation. The radiation induced alterations were always unidirectional for a given receptor. It is proposed that the mesenteric Pacinian corpuscle be identified as one of the radiation sensitive visceral receptors potentially capable of mediating body-only irradiation effects on the EEG and behavior. (auth)

34651 EFFECTS OF X-IRRADIATION ON THE MANDIBULAR CONDYLE. Furstman, Lawrence Leonard. Los Angeles; Univ. of Southern California (1969). 201p.

Thesis.

The purpose of this investigation was to examine rats that had received total-body irradiation in order to determine if any mor-

phological changes could be found and if so, to determine the effects of this irradiation on the bone and cartilage of the mandibular joint. Further objectives were to determine the effect of natural shielding of the condyle, to elicit clues to varied human clinical problems and to form conclusions concerning possible changes from normal growth and developmental patterns as well as rate of growth. Thirty white male weanling rats were exposed to 600 R total-body irradiation. Thirty white male weanling rats were not irradiated but were pair fed to serve as inanition controls. Thirty white male weanling rats were not irradiated and were fed ad libitum. Five animals of each group were sacrificed at 1, 3, 5, 7, and 28 day intervals after the irradiation date. At sacrifice heads and jaws and a tibia were prepared for nitrocellulose embedding. Tibias were also collected for studies of alkaline and acid phosphatase activity. Damage in the condyle following irradiation starts at day 1, peaks at day 3 and starts repair by day 5. Osteoclasts are seen in the condyle at 1 day postradiation and more osteoclastic activity is seen than is observed in the tibia where osteoclasts are not seen until 3 days after radiation. The loss of the calcifying matrix of the condyle is almost entirely due to osteoclastic activity. Less congestion and hemorrhage are seen in the condyle. The tibia shows a maximum loss of trabeculae and marrow elements at day 5 and starts its return to normal on day 7. The cartilage of the condyle requires 28 days to repair. Changes noted were specific for radiation damage and were not caused by nutritional deficiencies. The pair-fed animals resembled the ad libitum nonirradiated animals in proportion of parts but with a notable decrease in size. Radiation caused a decrease in alkaline phosphatase activity in the epiphyseal plate. This was noted particularly in the hypertrophied zone and along the trabeculae. From 1 day post radiation there was a gradual increase in alkaline phosphatase granules in the marrow. Radiation increased acid phosphatase activity particularly at the metaphyseal border of the epiphyseal plate and both extra- and intracellularly in the marrow. The increase in acid phosphatase activity may be explained in part by the great increase in numbers of osteoclasts following radiation. Also macrophages of the marrow may disintegrate and release their hydrolytic enzymes. The condyle of the mandible was more sensitive to somatic radiation than the tibia. It was apparent that any natural shielding offered by the bony concavity of the mandibular joint offers little if any protection from radiation. Changes in the shape and contours of the mandibular condyle of the rat following exposure to 600 R of somatic radiation are severe enough to point out the fact that radiation exposures must not be overlooked as a possible reason for morphologic changes in the condyles of humans which could contribute to TMJ problems. The cessation of bone growth in the condyle of the young growing animal following x irradiation must cause a change in the developmental growth pattern. Radiation resulted in an arrest of the morphologic pattern. While subsequent appositional growth is the usual or normal growth it must be remembered that it is now being imposed upon a distorted pattern. (Disser. Abstr.)

34652 ULTRASTRUCTURAL CHARACTERISTIC OF THE CAPILLARY WALL WITH UPSET OF ITS BARRIER FUNCTION. Alekseev, O. V.; Chernukh, A. M. (Inst. of Normal and Pathological Physiology, Moscow). Byull. Eksp. Biol. Med.; 67: 110-3(Feb 1969). (In Russian).

Electronic microscopy showed that 3 hours following general x irradiation (600 R) of mice, lung blood capillaries have edema of endothelial cells, local breakdown, increased microvesiculation, vacuolization and formation of bullae, moderate dilatation of intercellular space, separation of endothelium from the basal membrane, and also various changes in the basal membranes up to their complete breakdown. Similar, but less pronounced changes were found in the glomerular capillaries in the kidneys. In splenic sinuses and in hepatic sinusoids there was destruction of endothelial and reticulo-endothelial cells with vacuolization. There was no inflow of intravenously injected particles of Chinese ink from the pulmonary and glomerular capillaries both in the intact and in the irradiated animals. The liver and spleen showed increased absorptive activity of the reticulo-endothelial cells and accelerated breakdown of the sheaths of the phagocytic vacuoles. Irradiated animals had Chinese ink particles in the liver cells. None were seen in the control group. (auth)

34653 THE EFFECTS OF LOW LEVEL MICROWAVE IRRADIATION UPON REFLEXIVE, OPERANT, AND DISCRIMINATION BEHAVIORS OF THE RAT. King, Nancy Williams. Lawrence, Kan.; Univ. of Kansas (1969). 114p.

Thesis.

The aim was to determine whether low, moderate, and high levels of microwave irradiation, with reference to the 10 mW/cm^2 safety limit imposed by current U. S. convention, would affect reflexive, operant, and discriminative behaviors. The response studied was the tongue-lick of six male Sprague–Dawley albino rats on a photo-operandum under multiple fixed-ratio, extinction schedules. Irradiation was by 2450 MHz em energy, modulated at 60 Hz and at 12 Hz in a Tappan electronic range, closed-space situation. Reflexive behavior was studied in terms of the respondent lick burst that occurs when a rat receives a drop of liquid on its tongue. The data are slightly, but not reliably, indicative of a curvilinear relation between irradiation level and reflexive lick rate. The operant behavior studied was again the tongue-lick, but in this case global responding on a multiple fixed-ratio, extinction schedule. Such responding was disrupted by moderate power levels of 3.0 to 3.2 mW/gm (10 mW/cm^2) presented intermittently throughout the session in five min on, five min off periods. Two animals ceased responding completely, and the rest responded less than on control days. At high power levels of 4.4 to 4.7 mW/gm (15 mW/cm^2), all animals ceased responding before the end of the third irradiation period. Low-level irradiation (1.5 to 1.7 mW/gm) lowered responding when presented together with the tone stimulus. Discriminative behavior was primarily examined in terms of whether microwave irradiation at low levels could act as a discriminative stimulus in a multiple schedule. There was no evidence to suggest this even though acoustic and visual stimuli were well discriminated. Moderate and high levels of irradiation were not studied in this situation because such levels were found to produce gross behavioral disruption. The effect of irradiation on a different sort of discriminative behavior, the discrimination of a tone stimulus in the multiple schedule, was also studied. Although microwave irradiation disrupted the operant behavior in terms of overall responding, it did not disrupt discrimination performance on the multiple schedule. At the high level of irradiation, performance actually improved for those animals for whom the tone was discriminative for reinforcement rather than extinction. Sometimes at the moderate and always at the high levels of irradiation there was a curare-like effect on the animals; they became immobile, then flaccid. Both skeletal and gut muscles were atonic. Deep rectal temperatures taken after a session under high level irradiation were significantly elevated. No convulsions or signs of agitation were observed, and there were no indications that the experimental situation became aversive under any of the irradiation levels tested. (TSS) (Disser. Abstr.)

34654 RADIOBIOLOGY OF THE MONGOLIAN GERBIL (MERIONES UNGUICULATUS). Nelson, John Munroe. Ann Arbor, Mich.; Univ. of Michigan (1969). 152p.

Thesis.

The Mongolian gerbil, Meriones unguiculatus, has been reported to be a radioresistant animal. Preliminary experiments indicate an $LD_{50/30}$ of approximately 1000 R to 250 kVp x rays, while the lethal range extends from 800 R to 1200 R. Analysis of survival time shows the CNS syndrome to be similar to that of most mammals since the survival time falls to less than four hours at 80,000 R. Similarly, the bone-marrow syndrome deaths occur within two weeks at 840 to 1200 R. On the other hand, the gastrointestinal syndrome extends from 1200 R to 15,000 to 20,000 R with deaths occurring from seven to ten days. The relatively long survival time following an exposure capable of initiating the gastrointestinal syndrome suggested further investigation of gastrointestinal injury. Autoradiographic studies demonstrated that the time required for renewal of ileal mucosa was in excess of 120 hours in the gerbil as contrasted to approximately 48 hours for the mouse. It was suggested that the slower rate of cell renewal and longer turnover time was, in part, responsible for the longer survival time. Histopathological studies of ileal mucosa from irradiated gerbils have confirmed this suggestion. Similar studies have demonstrated that the mechanisms involved and the apparent cause of death in the lethal range are essentially the same in both the Mongolian gerbil and the mouse. The discrepancy between mean lethal doses was found to reflect a difference in the rate of, and capacity for, functional repopulation of hemopoietic tissue between the two animals. (Disser. Abstr.)

34655 STUDY OF THE LEUKOPOIETIC PLASMA ACTIVITY OF IRRADIATED RABBITS AND RATS. Markosyan, V. A. (Radiobiology Section, Erevan). Biol. Zh. Arm.; 22: No. 9, 69-72(Sep 1969). (In Russian).

Healthy rabbits and rats were given a single, whole-body, x-ray dose of 600 R. The level of leukopoietic activity of the plasma was determined by an in vivo and by an in vitro method in the rabbits at 7 and 14 days, and in the rats at 1, 3, and 7 days after the irradiation. The number of leukocytes in the peripheral blood, and also the content of elements of the leukoblastic series of the bone marrow and the mitotic activity of these elements in animal recipients given plasma injections from the irradiated animals served as indices of shifts in the level of leukopoiesis. The leukopoietic activity was also estimated on the basis of a reading of the mitotic activity of cells of leukoblastic growth in a bone-marrow culture. The normal plasma of healthy rabbits and rats

stimulated leukopoiesis on injection into animal recipients. The degree of stimulation was determined experimentally. On the other hand, blood plasma taken from irradiated animals suppressed the growth of leukoblastic cells, and led to a decrease in the mitotic activity of these cells. The greatest change in leukoblastic activity of the blood plasma was observed 7 days after irradiation in the rabbits, and 3 days after irradiation in the rats. These shifts in leukopoietic activity are considered to be pathological. (TTT)

34656 RENAL EXCRETION OF EXOGENOUS ACID AFTER X-IRRADIATION OF THE DOG. Welbourne, Tomas C.; Spurr, G. B. (Univ. of Tennessee, Memphis). Radiat. Res.; 42: 513-18(Jun 1970).

An exogenous acid load was administered to dogs prior to and 7 days after 400 R x-irradiation to determine whether the kidney could excrete acid during the period of metabolic acidosis that follows x-irradiation, and to what extent acid-excreting capacity was changed. It was observed that the acid-excreting capacity of the kidney was reduced by about 40% after irradiation. The reduction was the result of a decrease in both ammonium and titratable acid excretion. There was a resemblance between the inability to excrete acid after irradiation and that observed by others in adrenal insufficiency. (auth)

34657 EFFECT OF DEHYDROCHOLIC ACID ON BILE SECRETION IN EXPERIMENTAL RADIATION SICKNESS. Skakun, N. P.; Lobunets, V. S. Farmakol. Toksikol.; 32: 579-82(1969). (In Russian).

Tests on albino rats brought evidence that following exposure to x-rays at a dose of 750 R marked changes occur in the sensitivity of the liver to dehydrocholic acid. As the degree and duration of the drug's action diminish, the relation between drug dosages and the extent of response also decreases. There was a more marked response to a smaller dose than to a higher one. Conversion of the stimulating action of the drug on biliation into a depressing one is possible. (auth)

34658 ACTION OF CYTOTOXIC AGENTS ON THE ERYTHROID SYSTEM OF THE MOUSE. Twentyman, P. R.; Blackett, N. M. (Inst. of Cancer Research, Sutton, Eng.). J. Nat. Cancer Inst.; 44: 117-23(Jan 1970).

Dose-response curves were obtained for the effects of five cytotoxic agents on the repopulating and maturing cells of the erythroid system in the mouse. The curves were determined both in normal animals and animals in which cellular proliferation was modified by 2 weeks' exposure to continuous γ-irradiation. It was found that x rays and dimethylmyleran had similar effects on maturing and repopulating cells, and continuous irradiation made no difference in the response. Methotrexate, vinblastine, and actinomycin D, however, had considerably greater effect on the maturing than on the repopulating cells in normal mice, although, in irradiated animals, the sensitivity of repopulating cells was considerably increased. This difference in the sensitivity of the two stages of maturation appears to be largely a consequence of their different rates of proliferation. The possible implications of these results for chemotherapy are discussed with particular reference to regimens of fractionation and drug combinations. (auth)

34659 ACETYLATION OF PABA IN PERFUSED ISOLATED RAT LIVER IN THE COURSE OF ACUTE RADIATION SICKNESS. Kvetina, Jaroslav; Fendrich, Zdenek Sb. Ved. Pr. Lek. Fak. Karlovy Univ. Hradci Kralove; 11: 765-8(1968).

Isolated perfused rat liver is capable of acetylation of p-aminobenzoic acid (PABA). Relatively high concentrations of acetylated metabolites of PABA and hardly any free PABA are detectable in the bile taken from isolated perfused rat liver. In the course of acute radiation sickness (6 days after radiation exposure) an increased acetylation of PABA occurs in rats. In this postirradiation interval one can observe a slightly increased elimination of acetylated metabolites in the urine after intravenous administration of PABA and an increased formation of acetylated metabolites in isolated perfused rat liver. (auth)

34660 EXPERIMENTAL NEPHROPATHY IN THE RAT AFTER SUBTOTAL NEPHRECTOMY AND X-RAY IRRADIATION OF THE REMAINING KIDNEY. Loreau, N.; Morel-Maroger, L.; Ardaillou, R. (Hospital Tenon, Paris). Rev. Fr. Etud. Clin. Biol.; 15: 321-5(Mar 1970).

Subtotal $^5/_6$ th nephrectomy followed by x-ray irradiation produces a reproducible nephropathy with renal failure. Forty rats are divided into two groups: 23 nephrectomized and irradiated animals are compared to 17 sham operated. In all experimental animals, renal failure is obtained. The initial renal lesions observed consist of focal cellular interstitial infiltration without any glomerular or vascular abnormalities. Then, from four to eight weeks after irradiation, diffuse subacute necrotizing glomerulonephritis appears. After the twentieth week, focal glomerulitis is the only abnormality found. This lesion may be considered as a scarring process. (CEA, France)

34661 STERILITY DUE TO RADIOACTIVE PHOSPHORUS IN MICE: A STUDY OF OVARIAN COMPENSATORY HYPERTROPHY. Holmberg, E. A. D.; Pasqualini, Christiane Dosne; Rabasa, S. L. (Academia Nacional de Medicina, Buenos Aires). Acta Endocrinol.; 62: 133-46(Sep 1969).

The administration of 60 μCl of ^{32}P to pregnant BALB mice induced sterility in the offspring due to destruction of the gonads. The testes presented aspermatogenesis, trophic Leydig cells and normal secondary sex characteristics. The ovaries showed reabsorption of the primary and secondary follicles, absence of ovulation and progressive luteionization of the stroma, as well as atrophy of the uterus and dioestrus. Apart from the alteration in the pituitary feedback mechanism as a result of these gonadal lesions, a direct effect of ^{32}P on the hypothalamic-hypophyseal axis was observed. In these animals the uptake of ^{32}P by the hypothalamus was significantly lower than in normal or castrated controls. The compensatory hypertrophy of the ovary, 1 month after hemicastration was significantly decreased. The intrarenal grafting of a normal ovary in a ^{32}P-treated host led to lower compensatory hypertrophies than in normal hosts, as determined both 1 and 3 months after grafting. These results were obtained in female and male hosts of 1, 3 and 6 months of age, with transplanted ovaries aged 1, 3 and 6 months respectively. In all the groups, ovarian compensatory hypertrophy was higher in the male than in the female hosts, but the differences between ^{32}P treated and normal hosts were more significant in the females. This difference persisted even when castration of the host was carried out 1 month before grafting of the ovary and when ^{32}P was administered 1 day after removal of the gonads, thus eliminating any secondary effect. It can be concluded that the administration of ^{32}P during foetal life, apart from causing lesions in the gonads, has a direct effect on the hypothalamus with subsequent alteration in the output of gonadotrophins. (auth)

34662 VARIATIONS IN CARDIAC SENSITIVITY IN IRRADIATED ANIMALS. Dovlatyan, S. V.; Melik-Israelyan, Sh. S. (Dept. of Public Health, Erevan). Biol. Zh. Arm.; 22: No. 10, 63-7(Oct 1969). (In Russian).

Cardiac muscle sensitivity to physical load and to oxygen deficiency during various stages of radiation injury was studied using 200 rats weighing 150 to 200 g, barbitalized (nembutal 30 mg/kg wt) and irradiated with 450 to 500 R. The results indicated enhanced heart sensitivity to oxygen deficiency, which was strongly pronounced during the acute stages of sickness, indicating deep disturbances of biochemical processes in cardiac muscle. (R.V.J.)

34663 EFFECTS OF RADIATIONS ON EXPERIMENTAL ARRYTHMIAS: THE ROLE OF THE CENTRAL NERVOUS SYSTEM. Jurkovic, V.; Vokrouhlicky, L. (Deuxieme Clinique Medicale, Hradec Kralove, Czech.). Union Med. Can.; 97: 1091-6(Aug 1968). (In French).

A comparison is made of the effects of heart versus head irradiation in different experimental situations leading to a variety of arrhythmia in the rabbit. On the ground that many effects produced by heart irradiation also occurred after head or central nervous system (CNS) irradiation, it is proposed that the role of the CNS is important. This may be at play in the production of the arrhythmia itself or may be called into action by certain drugs, such as procaine to regulate the artificially induced abnormal rhythm. (auth) (Canada)

34664 EFFECT OF X-IRRADIATION ON ACTIVITY OF SYMMETRIC DIVISIONS OF CEREBRAL CORTEX IN DOGS. Medyanik, I. A. (Voronezh Univ., USSR). Fiziol. Zh.; Akad. Nauk Ukr. RSR; 15: 781-8(Nov-Dec 1969). (In Ukrainian).

After unilateral, bilateral, single, or fractional x irradiation (100 R × 4 or 25 R × 16) of the heads of dogs with a total dose of 400 R, phase changes were observed in the conditioned reflex activity of the symmetric divisions: momentary phase of decrease, phase of rise, long phase of lowering, and reducing period. The asymmetric phenomena are detected as well as parabiotic phase states. Depending on the method of irradiating the dog's head the reduction of the initial level of the conditioned reflex reactions of the symmetric divisions of cerebral cortex occurred in different periods. (auth)

34665 LASER-INDUCED ACOUSTIC TRANSIENTS IN THE MAMMALIAN EYE. Cleary, Stephen F.; Hamrick, Philip E. (Medical Coll. of Virginia, Richmond). J. Acoust. Soc. Amer.; 46: 1037-44(Oct 1969).

Retinal damage resulting from exposure to normal-mode and giant-pulse (Q-switched) laser radiation has generally been at-

tributed to thermal denaturation of retinal tissue, but, owing to the high-power densities produced by Q-switched lasers, other modes of tissue damage may be involved. One such mechanism, that is directly related to the power density of the laser beam, is the production of acoustic transients (pressure pulses) as a result of rapid thermal expansion following the absorption of laser radiation. An investigation was carried out to obtain quantitative information concerning the acoustic transients generated in the mammalian eye by the absorption of normal-mode and Q-switched laser pulses. A theoretical analysis indicated that acoustic transients with durations of the same order as the laser pulse (e.g., 100 nsec for a Q-switched pulse) and amplitudes of greater than 100 atm could be produced in model systems that simulate the retina. Piezoelectric transducers and a schlieren optical system were used to verify experimentally the theoretical predictions. By the use of these devices, studies were made of the production of laser-induced acoustic transients in the rabbit eye. An 18-mJ Q-switched ruby-laser pulse produced acoustic transients with amplitudes of 1000 atm in the immediate vicinity of the site of absorption, a 750-μ-diameter spot on the retina. Normal-mode laser pulses of the same energy but with durations of 0.5 msec produced a train of pulses with amplitudes 500 to 1000 times less than the Q-switched pulse. The biological significance of these findings is discussed. (BBB)

34666 DEMONSTRATION OF THE OXYGEN EFFECT IN IRRADIATED BRAIN. Hopewell, J. W.; Wright, E. A. (St. Mary's Hospital Medical School, London). Int. J. Radiat. Biol.; 16: 593-6(1969).

While 7-day-old rats were breathing atmospheres of 7, 20, 100 or 300% (three atmospheres) oxygen the left half of the brain was irradiated with doses of 200 to 1000 R of 220 kV x rays. 1, 3 and 7 weeks later the animals were killed, and the weights of the irradiated and nonirradiated halves of the brain were compared. The differences were small, but showed a consistent trend over the doses and oxygen tensions used. The difference between animals irradiated in 7% oxygen and in 300% oxygen was significant ($P < 0.01$). The data suggested a DMF of approximately 2 for irradiation in 300% oxygen as compared with 7% oxygen for developing rat brain. (auth)

34667 REGENERATION AND PROLIFERATION KINETICS OF NORMAL AND X-IRRADIATED TRANSITIONAL EPITHELIUM IN THE RAT. Schreiber, H.; Oehlert, W.; Kugler, K. (Univ., Freiburg i. B.). Virchows Arch.; 4B: No. 1, 30-44(1969). (In German).

During the regeneration process of transitional epithelium there is, contrary to other theories, a general movement of deeper cells towards the surface layer as is shown by radioautographic observations. Based on the labeling index after injection of thymidine-^{3}H and the supposition of a median DNA-phase of seven hours, the renewal time of the bladder epithelium was found to be at least 240 days. The renewal time of superficial cells was found to be about 24 days. The replacement of worn-off surface layer cells is related only to the total number of cells that follows after mitosis in the intermediate and basal cell layers and to a lesser degree after mitosis of superficial cells; transitional epithelium has no particular regenerative layer. In epithelial cells with a higher proliferation rate (injury by Trichosomonoides crassicauda) it was found that the labeling index, which is physiologically equal in all types of cells, is increased in basal and lower intermediate cells. Cell divisions occur parallel to the surface epithelial layer. It is highly probable that cells produced by division of superficial and upper intermediate cells do not possess any processes extending downward to the basement membrane. Thus only with this restriction may the bladder epithelium be called multilayered but not stratified as it is probable that vital cells exist without basal anchorage. The changes caused by experimental x-ray damage were histologically and radioautographically studied. Although epithelial cells of the normal resting bladder physiologically proliferate slowly, after high x-ray dose proliferation was quick and complete. In contrast, a strongly proliferating epithelium induced by injury from Trichosomonoides crassicauda showed severe damage and bad healing after a much smaller dose of x rays. (auth)

34668 SUMMATION OF THE BIOLOGICAL EFFECT OF LASER RAYS GIVEN IN FRACTIONATED DOSES. Szende, Bela; Mester, Endre; Tota, G. Jolan (Medical Univ., Budapest). Kiserl. Orvostud.; 21: 477-80(Oct 1969). (In Hungarian).

The summation of the biological effect of laser rays was studied. The growth inhibition of the fur of C57Bl mice was used as a test object. It was found that a nearly identical biological effect is exerted by laser rays whether administered in a single large dose or in fractions. (JPRS)

34669 EFFECTS OF PRENATAL X-IRRADIATION ON THE ONTOGENESIS OF ACETYLCHOLINESTERASE AND CARBONIC ANHYDRASE IN RAT CENTRAL NERVOUS SYSTEM. Nair, V.; Bau, D. (Chicago Medical School). Brain Res.; 16: 383-94 (1969).

Effects of prenatal x irradiation on the ontogenesis of carbonic anhydrase and acetylcholinesterase in rat central nervous system have been studied. In both male and female offspring of irradiated mothers, development of acetylcholinesterase was impaired in the caudate nucleus. Ontogenesis of carbonic anhydrase, on the other hand, was suppressed in the medulla and spinal cord of male rats while a slight stimulation was noted in the females. In the spinal cord, the stimulation was noted beyond 80 days of age. Approaches towards understanding the mechanisms underlying these effects and their possible functional significance are discussed. (auth)

34670 EFFECT OF TRAUMA ON PERIPHERAL BLOOD IN THE OFFSPRING OF CHRONICALLY IRRADIATED ANIMALS. Dokuchaeva, N. F.; Kagramanova, M. A. (Samarkand Medical Inst., Tashkent). Med. Zh. Uzb.; No. 7, 53-4(1969). (In Russian).

The quantitative composition of peripheral blood in the offspring of chronically irradiated rabbits (300 R) was virtually the same as in the control. Fracture of the metatarsal bone produced a distorted leukocyte reaction. The leukocyte count decreased by 2,000 to 4,000 below the original level during the first month after the injury and there were marked changes in the RBC. Anisocytosis was decreased in the erythrocyte count and hemoglobin concentration was decreased with the development of anemia. The control, on the other hand, exhibited only a temporary leukocytosis with no significant qualitative changes in the peripheral blood. (TSS) (JPRS)

34671 EFFECT OF SMALL DOSES OF LASER RAYS, ADMINISTERED REPEATEDLY OVER A LONG TIME PERIOD, ON THE SKIN AND INTERNAL ORGANS OF MICE. Szende, Bela; Mester, Endre; Tota, G. Jolan (Medical Univ., Budapest). Kiserl. Orvostud.; 21: 481-5(Oct 1969). (In Hungarian).

The skin on the abdomen of 10 male C57Bl mice was irradiated with a laser ray of 1 J energy/week, in 3 to 35 sessions. In response to the irradiation, first inflammatory phenomena, followed by destruction of the hair follicles and later by atrophy of the epithelium was observed on the skin. In addition to the latter, regenerational nodules originating from the basal cells of the epithelium also developed in certain cases. In some of the mice, liver necrosis or small intestinal necrosis developed. (JPRS)

34672 ELECTROPHYSIOLOGICAL CHANGES FOLLOWING LOCAL ELECTRON IRRADIATION OF THE BRAIN. Pasztor, Andras; Tomka, Imre; Sarkadi, Adam (National Neurosurgical Research Inst., Budapest). Ideggyogy. Szemle; 22: 374-9(Aug 1969). (In Hungarian).

The somatosensory area of the cat brain was irradiated with an electron ray obtained from a Van de Graaff generator. The post-irradiational electroencephalographic changes were studied with the help of epidural and deep electrodes. Within the limits of 50 to 210 kRad radiation, with increasing doses used, the rate of appearance of the irritative phase was increased and the activation of the curves became more pronounced. In addition to the activation of the curves, the excited behavior of the animals was also characteristic of the irritative phase. After one or two days of the irritative phase, it was followed by the depressive EEG phase which was characterized by the intact occipital α-activity in addition to the local permanent depression. In the case of 210 kRad doses, the changes were irreversible. There was an apparent normalization of the EEG picture in the case of 50 to 150 kRad doses although the electric activity remained depressed throughout, in the deep structures. The animals lost their sensory and tactile functions and none of them regained them during the 2 months survival period. The decreased electric activity found in the ventrobasal structures of the thalamus was correlated with the retrograde cell-degeneration developed through the thalamo-cortical connections. (JPRS)

34673 BIOPOTENTIALS OF CEREBRAL CORTEX IN RABBITS EXPOSED TO LOW-INTENSITY ELECTROMAGNETIC RADIOFREQUENCY FIELDS. Ershova, L. K.; Dumanskii, Yu. D. (Inst. of Total and Communal Hygiene, Kiev). Fiziol. Zh., Akad. Nauk Ukr. RSR; 15: 777-80(Nov-Dec 1969). (In Ukrainian).

As a result of chronic irradiation (for two months), a prevalence of slow non-regular biological currents was detected, which gives evidence for the progressive growth of the inhibitory state in the cortex of cerebral hemispheres of animals. Reduction of the electrical activity shifts was delayed up to two months in some cases. (auth)

34674 DYNAMICS OF THE CHANGES IN THE GRANULOCYTIC RESERVE OF BONE MARROW OF ANIMALS EXPOSED TO

CHRONIC GAMMA-IRRADIATION. Zubenkova, E. S.; Markelov, B. A. Kosm. Biol. Med.; 4: 3-6(Jan-Feb 1970). (In Russian).

Pyrogenic tests were made of the state of leukopoiesis in 1- to 3-year-old dogs weighing 10 to 15 kg and exposed for a year and a half to chronic ^{60}Co γ rays with doses of 25 to 225 rem/year. Tabulated data of the leukocytic reactions of the animals exposed to chronic irradiation combined with intramuscular pyrogenic injections revealed the functional condition of the marrow and indicated inhibition of granulocyte formation during 6 to 14 months of exposure to 150, 145, and 225 rem/year with a slow restoration of the marrow reserve on the 16th and 18th month. (R.V.J.)

34675 EFFECTS OF X RADIATION ON LEVELS OF IMMUNOGLOBULINS IN MICE. Bazin, H. (Institut du Radium, Paris). pp 101-12 of Radiation and the Control of Immune Response. Vienna; International Atomic Energy Agency (1968). (In French).

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A significant decrease in the levels of the four immunoglobulins was observed in irradiated animals. The IgM was the least modified since at the death of the animals its value was still 60% of the normal. On the contrary, the IgA was the most modified; its disappearance was immediate and rapid, and furthermore its concentration at the sixth to the eighth day corresponded to a decline of 80%. The values of the IgM and IgM were intermediate between the two preceding ones. The protection of the posterior limbs had no effect on the IgG and little effect on the IgA and IgM. (tr-auth)

34676 EFFECT OF BUTYL ALCOHOL AND DNA HYDROLYSATES ON CHANGES IN SOME BLOOD PARAMETERS IN ANIMALS, IRRADIATED BY FAST NEUTRONS. Chebotar'ov, E. Yu.; Ryabova, E. Z. (Inst. of Physiology, Kiev). Fiziol. Zh., Akad. Nauk Ukr. RSR; 15: 846-8(Nov-Dec 1969). (In Ukrainian).

The effects of butyl alcohol and DNA hydrolysates on changes in blood parameters in fast-neutron-irradiated animals were studied using 264 white male rats weighing 130 to 140 g, irradiated in a horizontal channel of VVRM reactor by fast neutron with a dose of 215 rad against γ background not exceeding 10%. The results showed that introduction of denatured DNA following the exposure stimulated the hematosis process while injection of butyl alcohol inhibited the process. (R.V.J.)

34677 SKIN REACTION TO HYPERBARIC OXYGEN IN THE PRESSURE CHAMBER (ANIMAL EXPERIMENTS). Teske, H.-J. (Ruhr Univ., Essen). Strahlentherapie; 139: 174-8 (Feb 1970). (In German).

The skin of pigs was irradiated with doses between 800 and 2000 R. The irradiation was done in pure oxygen at 2 atm. overpressure, the control animals were irradiated in air but also within the container. The skin reactions are markedly enhanced when irradiation is carried out in hyperbaric oxygen. Reactions were of the same intensity, even somewhat higher than of controls when the doses were reduced to one half. However, this factor will not appear in tumor radiotherapy, because the doses can be reduced due to the higher efficiency. It was concluded that fractionated doses will give better results. The observations made in clinical hyperbaroxic radiotherapy agreed with the experimental findings. (auth)

34678 GOITROGENIC RESPONSE AT SEQUENTIAL TIME INTERVALS AFTER 250 AND 500 RADS X-RAYS TO THE RAT THYROID. Donisch, I.; Swettenham, K. V. Brit. J. Cancer; 23: 833-9(Dec 1969).

Experiments were designed to determine whether the degree of impairment of goitrogenic response after irradiation of the rat thyroid is modified by variation of time interval between radiation and start of the goitrogenic challenge. Doses of 250 and 500 rads x rays were tested with time intervals of 0, 2, 4, 8 and 16 weeks between radiation and the start of one month's maintenance on 0.1% aminotriazole in the drinking water. Over 400 rats, including unirradiated controls, were used for each of the two radiation doses. Variation of time lapse showed no effect on degree of impairment after 500 rads. 250 rads produced no impairment at any time interval. Impairment of goitrogenesis proves to be a sensitive, dose dependent consistently measurable assay method of radiation damage to the rat thyroid. The lower threshold lies between 250 and 500 rads, probably a little higher than the lowest doses of x rays that produce thyroid tumors in adult rats. (auth)

34679 INVESTIGATIONS OF CALCIUM METABOLISM FOLLOWING LOCAL X IRRADIATION. X. SEX DEPENDENT VARIATIONS IN GENERAL REACTIONS. Babicky, A.; Ostadalova, I.; Kolar, J.; Parizek, J. (Daris Univ., Prague). Strahlentherapie; 139: 203-8(Feb 1970). (In German).

General metabolic reactions of the skeleton and its dependence on sex are investigated in male and female rats. The general metabolic reactions vary in both sexes before and after sexual maturation. The radiosensitivity is higher in males. It is shown that after local irradiation the skeletal reaction is influenced by hormonal mechanisms. (auth)

34680 EFFECT OF SERUM FROM IRRADIATED RATS ON GASTROINTESTINAL FUNCTION. Levy, C. K. (Boston Univ.); Ervin, F. R.; Garcia, J. Nature (London); 225: 463-4(31 Jan 1970).

It is known that a strong gustatory aversion may occur when an animal consumes a flavored fluid during exposure to sublethal doses of ionizing radiation, and similar aversive reactions have been observed when laboratory rats drank flavored water and were injected with a small amount of serum from a donor exposed to massive irradiation. The gastrointestinal tract exhibits transient functional changes when exposed to ionizing radiation, and it would seem that the gustatory aversion that follows radiation exposure is a conditioned response resulting from the association of a particular flavor with radiation sickness. A circulation energy absorption by-product that causes gastrointestinal disturbance may account for the malaise and the observed aversive reactions; this would not only be of significance for the behavioral investigations, but also of potential importance for clinical understanding and management. With a view to testing such a hypothesis, the effect of both crude serum and serum from irradiated donor rats on in vitro preparations of rat ileum and uterus was investigated. It was found that serum from both irradiated and control rats produced an immediate increase of tone, of several minutes' duration, but that with serum from irradiated donors the effect was more pronounced. In order to test the assumption that both samples contained bradykinin, which caused the increased tone and masked the irradiation effect, all in vitro solutions were perfused with sodium salicylate, a potent blocking agent for bradykinin. Under these conditions addition of the irradiated serum caused a marked and prolonged contractile effect in many ileum preparations, whilst the control serum had little effect. The data supported the notion that irradiation conditioned aversion is due to a humoral agent which produces noxious stimuli by affecting gastrointestinal smooth muscle function. Attempts were made to ascertain the nature of this humoral agent by chromatographic techniques and testing of the separated fractions. The findings strongly suggested that the aversion conditioning evoked by injection of serum from irradiated donors is caused by the effect of histamine on the gut. It also seems that the immediate transient contractile response of the gut to direct radiation exposure may involve release of bound histamine, as indeed may the early phase of radiation sickness. (UK)

34681 SYNERGISTIC ACTION OF RADIATION AND VIRUS IN INDUCTION OF LEUKEMIA IN RATS. Yokoro, Kenjiro; Ito, Takaaki; Imamura, Nobutaka; Kawase, Akira; Yamasaki, Takao (Hiroshima Univ.). Cancer Res.; 29: 1973-6(Nov 1969).

More than 50% of Wistar/Furth (W/Fu) strain rats, which received combined treatment with a fractionated total-body x-irradiation and an injection of a mouse leukemia virus (Gross virus), developed leukemia within seven months following treatment. The majority of the induced leukemias were thymic lymphomas with a short latency period similar to those observed in susceptible strains of mice and W/Fu rats after the neonatal inoculation of this virus. Also, a few cases of nonthymic lymphoid leukemia and myeloid leukemia of the chloroma type occurred with a longer latency period. Persistence and multiplication of the inoculated virus in leukemic rats were suggested by the development of leukemia in recipients which were inoculated at birth with cell-free filtrates prepared from these leukemic rats. In contrast to these findings, no leukemia occurred among rats which received either fractionated total-body x-irradiation alone or virus inoculation alone. As to the mechanism of leukemogenic synergism of radiation and virus, it is suggested that radiation acts as a modifier for both the physiologic state of the target cell of the virus and the immunologic responsiveness of the host. Thus, it might promote an interaction between the target cell and virus and a proliferation of antigenically altered leukemic cells. (auth)

34682 LIFETIME REPRODUCTIVE PERFORMANCE OF MICE EXPOSED AS EMBRYOS TO X-IRRADIATION. Nash, Donald J. (Colorado State Univ., Fort Collins). Biol. Bull.; 137: 189-201 (Aug 1969).

Lifetime fecundity and fertility were studied in mice that were irradiated at different stages of embryological development; changes induced in the developing reproductive system as reflected in total lifetime reproductive performance were noted. In addition, important genotypic-environmental interactions were investigated by studying the reproductive responses of several genetic backgrounds; the BALB, K, and S strains of mice and all their possible hybrids, including reciprocals were used. Pregnant females were exposed to single whole-body 250 pkV x-ray doses

from 20 to 320 R (dose rate of 133 R/min) on 6½, 10½, 14½, and 17½ days gestation, as timed from the vaginal plug appearance. Of the various treatment combinations, only irradiation at day 10½ with a dose of 80 R and above produced any gross congenital malformations. For both number of litters and number of progeny of mice that exhibited no congenital malformations and survived 75 days, separate analysis of variance for each of the embryological ages and for each of the irradiation doses was made; data are presented in tabular form. At a dose of 80 R (highest dose represented at all stages) day 10½ appeared to be more radiosensitive than the other three ages. At the lower doses, the response of the fetal testis appeared to be similar to that of the fetal ovary; also, the fetal testis at day 14½ was less sensitive than the fetal ovary, and at day 17½ the females were relatively more affected than males. With regard to genetics differences, reproductive capacity was influenced. Results indicated that hybrids were less affected by doses of 160 R and 320 R and that fecundity remained relatively normal until a dose of 320 R was reached. (C.O.)

34683 EXPERIMENTAL RADIATION-INDUCED HEART DISEASE. I. LIGHT MICROSCOPIC STUDIES. Fajardo, Luis F.; Stewart, J. Robert (Stanford Univ., Calif. Veterans Administration Hospital, Palo Alto, Calif.). Amer. J. Pathol.; 59: 299-315(May 1970).

One hundred and forty-two young New Zealand white rabbits received x radiation to the heart in single doses ranging from 1800 to 8250 rads, or fractionated doses of 5400 or 10800 rads in 12 fractions delivered in 28 days. After a single dose of 2000 rads, the animals developed a disease morphologically characterized by three sequential phases. Transient acute radiation pancarditis occurred between 6 and 48 hr. During a latent phase, lasting from 2 to 70 days, no significant lesions were present. Progressive pericardial fibrosis, pericardial effusion and diffuse myocardial fibrosis were typical of the late phase, beyond 70 days. One half of the animals sacrificed or dying during the late phase had evidence of heart failure; cardiac tamponade was the most common cause of death. The late lesions were identical to those observed in humans and were present in 94% of the rabbits. Fractionated radiation of 5400 rads caused late changes identical to those induced by a single dose of 2000 rads. Lesions caused by single doses above 2000 rads were similar, but frequently appeared earlier and were more severe. Irradiation of a portion of the heart did not change the character of the lesions and did not cause recognizable alterations in the shielded areas. Myocardial fibrosis is probably mediated through capillary injury. Unsatisfactory removal of fibrin due to defective plasminogen activation is one possible explanation of pericardial fibrosis. (auth)

34684 EFFECT OF X-RADIATION ON SALIVARY GLAND GROWTH IN THE RAT. II. QUANTITATIVE STUDIES OF SIALADENOTROPHISM INDUCED WITH ISOPROPYLNORADRENALINE AND ITS MODIFICATION BY SINGLE DOSES OF X-RAYS. van den Brenk, H. A. S.; Sparrow, Nancy; Moore, Valerie (St. Thomas' Hospital, London). Int. J. Radiat. Biol.; 17: 135-61 (1970).

Quantitative and histometric characteristics of sialadenotrophism induced in rats with isopropylnoradrenaline (ISOP) are described, with particular reference to rates of gland growth, rates of cell enlargement and cell proliferation in the submandibular (SM) salivary gland, and effects of ISOP on body-growth and heart weight. Glandular enlargement is principally due to hypertrophy (auxetic growth) and hyperplasia (replicative growth) of serous acinar salivary cells. Local irradiation of salivary tissues of rats before administration of ISOP caused a dose-dependent reduction of sialadenotrophism, 800 rads reducing gland growth by ~ =50 per cent. Histometric and autoradiographic studies showed that irradiation reduced growth by inhibiting cell replication, auxetic cell growth being radio-resistant. Cardiomegaly produced by ISOP in rats was also radio-resistant. X-radiation inhibits adaptive growth of SM and parotid glands to a similar degree, but dose-effect curves differ, and the reasons for this are discussed. Radiation effects measured during the first 6 days' treatment of rats with ISOP are essentially independent of dosage and duration of treatment with ISOP. Induction of growth with ISOP is specific for salivary acinar cells and is a simple, convenient technique which may be used for radiobiological studies concerned with quantitative effects of radiation on the proliferative capacity of a highly differentiated, slowly-dividing tissue in vivo. (auth) (UK)

34685 EFFECTS OF IONISING RADIATIONS ON SERUM PROTEINS OF THE DUCKLING. Paulov, S. (Univ., Comenius, Czech.); Demers, J. M. Rev. Can. Biol.; 28: 215-22(Dec 1969). (In French).

The growth rate, serum proteins, and serum lipoproteins were studied in white Pekin ducklings exposed to a single dose of ^{60}Co (400 or 800 R) when they were one day old. A lag in growth rate, proportional to the dose administered, was observed in the irradiated ducklings as compared with the controls. This growth lag was accompanied by specific changes in the blood protein content that were highly significant statistically, particularly after the fifth day following such treatment. In the serum of irradiated ducklings, there was an absolute diminution of all protein fractions (albumins and globulins) as well as change in the albumin and globulin ratio, with a relative increase of the globulin factor. The absolute diminution as well as the relative changes applied to the alpha and beta lipoproteins, equally. (auth) (Canada)

34686 CHANGES IN THE PROLIFERATIVE ACTIVITY OF YOUNG AND OLD MOUSE SKELETAL TISSUES FOLLOWING ^{60}Co WHOLE-BODY IRRADIATION. Tonna, Edgar A. (New York Univ., N. Y.); Pavelec, Mildred. J. Gerontol.; 25: 9-16 (1970).

The effects of whole-body ^{60}Co-gamma irradiation (25 to 800 rads) on the proliferative activity of the skeletal tissues of 322 young and old female mice were investigated using ^{3}H-thymidine autoradiography. The result showed an initial depression of labeling indices following irradiation at all doses in both young and old mice. This was followed by a rebound phenomenon which appeared to be largest in tissues which normally have the highest proliferative activity. In the endosteal osteogenic cells of old mice, the phenomenon appeared to be augmented with increasing dose of irradiation. It was concluded that young skeletal cells with greater proliferative activity than old cells are more responsive to irradiation at the dose levels used. However, old cell compartments are not capable of sustaining radiation damage as effectively as young skeletal cell populations. Except for endosteal osteogenic cells, no effective recovery was observed by older cells up to 14 days after irradiation, even to the lowest (25 rads) dose of irradiation used in the study. (auth)

34687 COMBINATION EFFECT OF 5-BROMO-2'-DEOXYURIDINE AND ^{60}Co IRRADIATION UPON ANIMAL TUMOR. Kobayashi, Tadayuki; Kawaji, Hisanori (Takeda Chemical Industries, Ltd., Osaka). Takeda Kenkyusho Nempo: No. 28, 106-15(Nov 1969). (In Japanese).

Assessments of the combination effects of BUdR and ^{60}Co γ irradiation on Yoshida sarcoma-bearing rats were carried out with the following results. With whole-body irradiation, marked life prolongation effects were observed in the Yoshida ascites sarcoma-bearing rats after intraperitoneal injections of 50 mg/kg × 5 of BUdR plus 300 R whole-body ^{60}Co γ irradiation. Further combinations of methotrexate 50 mcg/kg seemed to enhance the effect of BUdR. Cytological examination revealed that enlarged and multinucleated giant cells appeared in the population of Yoshida sarcoma cells after treatments of UBdR and these enlarged cells seemed to be sensitized to irradiation. Three hr after ^{60}Co irradiation karyorrhexes of tumor cells were observed in the ascites of rats pretreated with BUdR. Twenty-four to forty-eight hr after irradiation many abnormal mitotic figures, including chromosome bridges, scattering of chromosome, and multinucleated giant cells were observed in the group treated with BUdR and BUdR plus ^{60}Co. With local irradiation, marked inhibitions of growth of intramuscular transplanted Yoshida sarcoma and life prolongation effects of tumor-bearing rats were observed after intra-arterial infusion of BUdR (100 to 400 mg/kg) plus local ^{60}Co γ irradiation. Life spans of nontreated and only ^{60}Co-irradiated, tumor-bearing rats were about 16 days and those of BUdR (200 to 400 mg/kg) plus ^{60}Co treated rats were over 30 days. Possible mechanisms of actions of BUdR and irradiation were discussed on the basis of our experimental data and suggestions for clinical application of the present experimental results were presented. (NSA of Japan) (TSS)

34688 ANIMAL EXPERIMENT STUDIES ON THE PROBLEM OF COMBINED INJURIES. Messerschmidt, Otfried (Univ., Freiburg i. B.). Strahlenschutz Forsch. Prax.; 7: 179-99(1967). (In German).

In mice and rats, defined areas of back skin were surgically removed. Whole-body x radiation was given at various times either prior or subsequent to the surgical procedure. In non-irradiated control animals, complete healing of the skin lesion occurred within 16 days. Five hundred ten r whole-body radiation, administered two days after surgery, had no significant effect on the healing process; while radiation two days prior to surgery delayed the healing time strikingly. Skin lesions, prior to radiation exposure, had no significant effects on mortality; however, skin removal within 10 days after irradiation increased the mortality drastically. In addition, the effects of combination injuries (surgery and radiation) were studied with respect to hematology, serum electrophoresis, and total proteins. In general, skin lesions alone decrease both albumen and γ-globulin, while they increase α and β globulins. These changes in protein composition are enhanced when surgery is combined with radiation. (H.B.G.)

34689 HISTOPATHOLOGY OF RADIATION INJURY. Oehlert, Wolfgang (Univ., Freiburg i. B.). Strahlenschutz Forsch. Prax.; 7: 201-16(1967). (In German).

Rats received either 200 or 400 r of x radiation to the upper abdominal region and epithelial changes in the small intestine were studied after injection of tritium-labeled thymidine. Observed were inhibition of mitosis, inhibition of DNA synthesis, edema of the nucleus, and caryolysis. These changes occurred only in the intermitotic epithelium of the crypts but not in the postmitotic cells of the villi. Within these crypts, radiosensitivity of the epithelium decreases from the basis toward the border with the villi. Radiation injury appears as a decrease of the mitotic index which is probably caused by a blockage in the G-2 phase. The injury is explained as an interference with RNA synthesis and can be closely imitated by RNA synthesis inhibitors such as actinomycin. (H.B.G.)

34690 THE RADIOTHERAPY OF THE INTRAOCULAR MELANOBLASTOMA AS A BIOLOGICAL MODEL OF THE AMELANOTIC MELANOBLASTOMA 3 (FORTNER) OF THE GOLDEN HAMSTER. Lommatzsch, P.; Velhagen, K.-H. (Humboldt-Univ., Berlin). Arch. Klin. Exp. Ophthalmol.; 178: 317-28(3 Nov 1969). (In German).

In an attempt to develop a radiotherapy technique that might improve the salvage rate in patients with melanoblastomas, experiments were conducted in hamsters to evaluate optimal techniques. The Fortner amelanotic melanoma was implanted in the eye of 183 hamsters. The tumors were allowed to grow and then irradiated with 60-kV x rays at 610 R/min in single doses of 3000 or 5000 R. Irradiation followed tumor implantation from 1 to 7 days. The tumors grew rapidly and by the 7th day had filled the anterior chamber of the left eye in which they had been seeded. Neither dose of irradiation was effective in preventing the spread of the tumors, over half the animals showing massive metastases in the regional lymph nodes within a week after irradiation. Histological aspects of tumor infiltration of the eye are described, as well as radioinduced changes in the tumor cells. Radioautographic studies indicated a transient decrease in ^{32}P uptake by the tumor cells 24 to 72 hr after irradiation; then the rate of uptake increased. (BBB)

34691 THE EFFECT OF TRACER ^{32}P DOSES ON THE FUNCTION AND STRUCTURE OF MALE GONADS. Panajotow, D.; Kolarow, P.; Daszew, G.; Milanow, S.; Protics, M. Endokrynol. Pol.; 20: 303-9(1969). (In Polish).

Experimental studies on sexually matured male rats with radioactive phosphorus in doses used in the test for determining the spermatogenic activity are reported. The following parameters were studied at definite intervals: The accumulation of ^{32}P in the testicle, the influence of the isotope on the structure of the gonad and the RNA and DNA content in the cells of the embryonal epithelium. The peculiar dynamics of the accumulation of radiophosphorus was established reaching its highest peak at the 24th hour and a second, lower peak, on the 7th day. The histological and histochemical investigations of the testes of the various groups of animals do not show any noticeable deviations as compared with the control animals. The possible causes are discussed with a view to explain the peculiar dynamics of isotope accumulation in the testicle. On the basis of the conducted experiments, the indicated tracer dose of ^{32}P is considered harmless for the testicle. (auth)

34692 EFFECT OF ROENTGEN IRRADIATION ON EXPERIMENTALLY INDUCED SYNOVITIS IN RATS. Rissanen, P.; Rokkanen, P.; Julkunen, H. (Univ. Central Hospital, Helsinki). Ann. Chir. Gynaecol. Fenn.; 58: 244-6(1969).

The effect of irradiation on synovitis induced with oil of turpentine was studied in 36 adult rats. Single doses of 100, 500, and 1000 rads were used. Specimens were studied histologically and histochemically 4, 14, and 29 days after irradiation. Oil of turpentine caused marked aseptic synovitis. Twenty-nine days after irradiation with 500 rads a marked decrease in the number of inflammatory cells was observed and the endothelium and the whole synovial membrane were almost normal in appearance, although the connective tissue was still more abundant than normal. The same effect was even more conspicuous with a single dose of 1000 rads. (auth) (Finland)

34693 EFFECT OF PENICILLINS ON BARRIER FUNCTION OF GASTROINTESTINAL TRACT IN ACUTE RADIATION DISEASE OF MICE. Maleta, Yu. S. Antibiotiki; 14: 517-22(Jun 1969). (In Russian).

It was shown that one of the main mechanisms of unfavorable action of penicillins on irradiated mice was an increase in the damage to the intestine walls and permeability of the intestine barrier for organic substances with high molecular weight. After subcutaneous administration of penicillins with potassium ions, the damage of the intestine walls (estimated by sorption of neutral red), permeability of the intestine barrier for Evans blue and dissemination of the mouth mucosa with coli bacteria in irradiated mice were much lower than after administration of penicillins in isotonic solution of NaCl. (auth)

34694 CHANGES OF CHOLINERGIC REGULATION UNDER EFFECT OF SMALL DOSES OF INCORPORATED RADIOACTIVE SUBSTANCES. Milko, V. I. (Medical Inst., Kiev). Fiziol. Zh., Akad Nauk Ukr. RSR; 15: 797-804(Nov-Dec 1969). (In Ukrainian).

Administration to albino rats per os of small doses of ^{131}I (0.3 μCi/kg and 15 μCi/kg) and ^{32}P (0.4 μCi/kg and 4 μCi/kg) led to a stable activation of cholinergic effects. The activation was connected with activity increase in all the components of mediation cholinergic link occurring in a definite succession. The thresholds of the nervous effects on heart and skeletal muscle were lowered, the acetylcholine content in the same organs increased, and the activity of cholinesterase hydrolysis rose in auricle, ventricle, skeletal muscle, liver, and brain stem tissues. (auth)

34695 VOPROSY TKANEVOI RADIOCHUVSTVITEL'NOSTI. (Problems of Tissue Radiosensitivity). Balmukhanov, S. B. (ed.). Trudy Kazakhskogo Nauchno-Issledovatel'skogo Instituta Onkologii i Radiologii, Tom VI. Alma-Ata, USSR; Izdatel'stvo Nauka Kazakhskoi SSR (1969). 300p. (In English and Russian).

Separate abstracts were prepared for 55 of the 58 papers in the book; abstracts for one of the remaining papers appeared previously in NSA. The two remaining papers on oxygen tension as a function of hypothermia and oxidation-reduction potentials of transplanted tumors were not within the scope of NSA. (H.L.W.)

For abstracts of individual chapters see: 34126–34134, 34170, 34285, 34286, 34407–34418, 34516, 34517, 34551–34555, 34583–34591, 34696–34708, 34741, and 34764.

34696 PROBLEM OF RADIOSENSITIVITY DIFFERENCE OF TISSUES IN THE ORGANISM. Kuzin, A. M. (Inst. of Biophysics, Pushchino-on-Oka, USSR). Tr. Kaz. Nauch.-Issled. Inst. Onkol. Radiol.; 6: 3-6(1969). (In Russian).

Radiosensitivity of tissue is determined as one of its properties characterized by a number of features. Several factors such as the presence in a tissue of natural protective substances (precursors of primary radiotoxins), recovery system and its radiosensitivity, the state of some enzymic systems and their activation in the process of irradiation are playing an essential role parallel with chromosome volume and physiological state of the genetic structures during irradiation. Different effects of tissue interaction with the whole organism on its radiosensitivity during total and local irradiation are emphasized. The attention of radiologists is drawn to some possible ways of artificial modification of tumor tissue radiosensitivity. (auth)

34697 RADIOSENSITIVITY ANALYSIS OF SARCOMA S-1 IN RATS. Kubtik, L. N.; Eidus, L. Kh.; Yarmonenko, S. P. (Inst. of Biophysics, Pushchino-on-Oka, USSR. Inst. of Experimental and Clinical Oncology, Moscow). Tr. Kaz. Nauch.-Issled. Inst. Onkol. Radiol.; 6: 29-35(1969). (In Russian).

The effects of fractionated radiation on M1 sarcoma cells of rats were investigated. It was found that the inactivating dose was 500 R and that the inactivation of tumor cells was exponential. The proliferative activity of the cells was not affected by radiation. It is suggested that the effect of radiotherapy on rat sarcoma is diminished by intracellular reparation following small doses. It was established that the effect of radiotherapy is a function of the total dose and is not dependent on fractionation when single doses are large. (H.L.W.)

34698 ROLE OF CHROMOSOME CHANGES IN THE FORMATION OF TUMOR RADIORESISTANCE. Efimov, M. L.; Kleinbok, T. S.; Nugmanov, E. U.; Arkhipova, L. D. (Inst. of Oncology and Radiology, Alma-Ata, USSR). Tr. Kaz. Nauch.-Issled. Inst. Onkol. Radiol.; 6: 46-51(1969). (In Russian).

Radioresistant sublines of Ehrlich ascites carcinoma were irradiated in vivo and in vitro before 46 transplantations. The cell karyotype of the radioresistant subline is characterized by the smaller chromosome number (44 as compared with 46 in the initial carcinoma). The radioresistance of the tumor is not affected by the organism bearing the tumor. (H.L.W.)

34699 RADIOSENSITIVITY ANALYSIS OF TWO ASCITES TUMORS BY THE CRITERION OF POST-RADIATION INOCULABILITY. Arkhipova, L. D.; Ismailov, B. I. (Inst. of Oncology and Radiology, Alma-Ata, USSR). Tr. Kaz. Nauch.-Issled. Inst. Onkol. Radiol.; 6: 52-8(1969). (In Russian).

Ascites tumors of the rat ovary and Pliss lymphosarcomas were

irradiated in vivo and in vitro. Lethal doses for ovarian tumors were 15,000 R (after transplantation of $5 \cdot 10^6$ cells) and 5,000 R (after transplantation of 10^6 cells) respectively. Two months after a 5,000 R dose, the inoculability was 100% for ovarian tumors and 13% for Pliss lymphosarcomas. The minimum number of cells for transplantation and differences in radiosensitivity of cells are discussed. (H.L.W.)

34700 RADIOSENSITIVITY OF TUMORS IN CONNECTION WITH THEIR MORPHOLOGICAL AND CHEMICAL HETEROGENEITY AND PROLIFERATION SPEED. Arkhipova, L. D.; Ismailov, B. I.; Zhemaletdinov, F. G. (Inst. of Oncology and Radiology, Alma-Ata, USSR). Tr. Kaz. Nauch.-Issled. Inst. Onkol. Radiol.; 6: 59-64(1969). (In Russian).

Cells of ovarian tumors and Pliss lymphosarcomas of rats were studied with regard to fluctuation of protein content and morphology. Cells of ovarian tumors showed more fluctuation than those of lymphosarcomas. The role of morphology, chemical heterogeneity, and proliferative ability of cells in relation to differences in radiosensitivity of the tumors is discussed. (auth)

34701 CYTOLOGICAL ANALYSIS OF RADIOSENSITIVITY OF ASCITES TUMORS OVARY AND PLISS LYMPHOSARCOMA RATS. Arkhipova, L. D.; Ismailov, B. I. (Inst. of Oncology and Radiology, Alma-Ata, USSR). Tr. Kaz. Nauch.-Issled. Inst. Onkol. Radiol.; 6: 65-9(1969). (In Russian).

The degree of inhibition of mitotic activity and decrease of the total number of cells as well as the duration of these events following x radiation was more marked in Pliss lymphosarcoma than in ovarian tumors of rats. It was concluded that ovarian tumors are more radioresistant than lymphosarcomas. (auth)

34702 SOME PECULIARITIES OF POST-RADIATION RECOVERY IN A RADIORESISTANT SUBLINE OF EHRLICH'S ASCITES TUMOR. Nugmanov, E. U. (Inst. of Oncology and Radiology, Alma-Ata, USSR). Tr. Kaz. Nauch.-Issled. Inst. Onkol. Radiol.; 6: 70-1(1969). (In Russian).

A radiation dose of 2,000 R was administered to an Ehrlich ascites carcinoma and its radioresistant subline in vitro. Varying numbers of tumor cells (500 thousand to 20 million) were then transplanted to rats. Transplants of 500 to 700 thousand cells of the radioresistant subline were 100% successful. A transplant of 500 thousand cells of the original tumor was not successful, but a transplant of 700 thousand cells resulted in 40% success. (auth)

34703 INVESTIGATION OF ACQUIRED RADIORESISTANCE OF SARCOMA 45 IN RATS. Imangalieva, N. T. (Inst. of Oncology and Radiology, Alma-Ata, USSR). Tr. Kaz. Nauch.-Issled. Inst. Onkol. Radiol.; 6: 84-6(1969). (In Russian).

Local radiation in single doses of 2500 R or triple doses of 1000 R was administered in vivo to sarcoma 45 in rats. Following a series of transplants, it was observed that the radiosensitivity of the singly irradiated tumors was unchanged, while there was an increased radioresistance in the triply irradiated tumors. (auth)

34704 NATURE OF TISSUE RADIOSENSITIVITY IN LIVING ORGANISMS. Minaev, P. F. (Inst. of Biophysics, Pushchino-on-Oka, USSR). Tr. Kaz. Nauch.-Issled. Inst. Onkol. Radiol.; 6: 92-4(1969). (In Russian).

The concept of radiosensitivity and radiostability as a distinct biological process is applied to cells and tissues of all living organisms. Changes in functions and structures of organisms are discussed with relation to their radiosensitivity. Formulas are presented for expressing radiosensitivity of cells and tissues. (auth)

34705 HETEROGENOUS REACTION OF SOLID LYMPHOSARCOMA TO THE COMBINED ACTION OF 5-DESOXYURIDINE AND X-RAYS. Pelevina, I. I.; Afanas'ev, G. G.; Lipchina, L. P.; Emanuel, N. M. (Inst. of Chemical Physics, Moscow). Tr. Kaz. Nauch.-Issled. Inst. Onkol. Radiol.; 6: 129-32(1969). (In Russian).

Iododeoxyuridine was repeatedly injected into mice that were transplanted subcutaneously with lymphosarcoma NKLy. The tumors were locally x-irradiated. The combined effects of IUdR resulted in twice as many tumor regressions as that caused by radiation alone. A heterogeneous reaction of the tumors was shown by analyses of growth patterns. The significance of radiosensitivity variations is discussed with regard to the relation between the degree of radiosensitivity induced by IUdR and the number of cells synthesizing DNA. (auth)

34706 EXPERIMENTAL STUDY OF COMBINED ACTION OF CHEMOTHERAPEUTICS AND X-RAYS UPON MUCOUS LIVER CANCER RS-1. Bokaeva, S. S.; Kabiev, O. K.; Balmukhanov, S. B. (Inst. of Oncology and Radiology, Alma-Ata, USSR). Tr. Kaz. Nauch.-Issled. Inst. Onkol. Radiol.; 6: 141-7(1969). (In Russian).

Different mixtures of cyclophosphanes, thiophosphamide, sarcolysin, and 5-fluorouracil were used in combination with radiation to treat the transplantable tumor RS-1 in rats. In almost all cases combined therapy was more effective than irradiation or medication alone. Antitumor effects in combined therapy did not depend on the time elapsed between drug administration and irradiation or on the method of administration of the drugs. Sarcolysin and 5-fluorouracil were more effective when given at the same time than when administered alternatively. (auth)

34707 RADIOSENSITIVITY OF RS-1 TUMOR IN IRRADIATION DURING HYPOTHERMIA. Chulanova-Nurkina, M. T. (Inst. of Oncology and Radiology, Alma-Ata, USSR). Tr. Kaz. Nauch.-Issled. Inst. Onkol. Radiol.; 6: 215-18(1969). (In Russian).

RS-1 tumors were transplanted subcutaneously into the subcostal region of rats. Following exposure to hypothermia the tumor was irradiated with a 3000 R dose. Inhibition of tumor growth was more marked than following irradiation alone. Radiation damage to normal tissues was decreased by hypothermia. (auth)

34708 EFFECTIVENESS OF IRRADIATION OF TRANSPLANTED TUMORS DURING TOURNIQUET ANOXIA DEPENDING ON THE TIME OF ITS REMOVAL. Gordienko, G. P. (Inst. of Oncology and Radiology, Alma-Ata, USSR). Tr. Kaz. Nauch.-Issled. Inst. Onkol. Radiol.; 6: 226-9(1969). (In Russian).

Sarcoma 45, sarcoma M-1, and Pliss lymphosarcoma were transplanted subcutaneously in the thigh of rats and were irradiated with single doses of 2000 and 3000 R. A tourniquet was applied proximally to the tumor 30 min before irradiation and removed immediately or 30 min after irradiation. Subsequent growth of the tumors was most inhibited when the tourniquet was kept on for 30 min after irradiation. Results suggested that the oxygen level of tissues influences post-radiation processes in the cell. (auth)

34709 BONE-MARROW SYNDROME IN CBA MICE EXPOSED TO FAST NEUTRONS OF 1.0 MeV MEAN ENERGY. EFFECT OF SYNGENEIC BONE-MARROW TRANSPLANTATION. Davids, J. A. G. (Reactor Centrum Nederland, Petten). Int. J. Radiat. Biol.; 17: 173-85(1970).

After whole-body exposure to fast neutrons of high LET in the lethal dose-range ($LD_{50/30d}$ 351 ± 2 rads) male mice of the inbred CBA strain die mostly between 8 and 15 days after irradiation. Death is mainly due to haematopoietic damage, as evidenced by the protection afforded by syngeneic bone-marrow transplantation. By increasing the neutron dose into the supralethal range, the effectiveness of bone-marrow therapy is decreased by the growing prevalence of the intestinal syndrome ($LD_{50/5d}$ 452 ± 4 rads). Female mice have the same sensitivity as regards haematopoietic damage ($LD_{50/30d}$ 348 ± 2 rads) but are slightly more sensitive to intestinal injury ($LD_{50/5d}$ 423 ± 3 rads). In spite of the bone-marrow transplantation, the probability of death between 10 and 15 days also increases with neutron dose, presumably as a result of the severe damage to the gastric epithelium, which appears at the same time. (auth) (UK)

34710 EFFECTS OF THE COMBINATION OF CYTOTOXINS AND X RAYS ON THE BONE MARROW OF RATS. CLINICAL DEDUCTIONS AND INTIAL RESULTS. Maisin, H.; Salamon, E.; Longueville, J. (Univ., Louvain, Belg.). Rev. Med. Liege; 23: Suppl. No. 1, 155-61(Oct 1968). (In French).

Effects on bone marrow of rats of treatment with an x-ray dose of 80 R combined with cytotoxins such as endoxan, myleran, methotrexate, fluoro-uracil, a microbial cytotoxin, sanamycin, or a plant cytotoxin, velbe were discussed. The bone marrow depression produced by combinations of these cytotoxins with the x irradiation varied and extended over time periods that exceeded 6 days following administration. The agents that produced short-term effects of about one day included cytotoxins such as nitrogen mustard, leukeran, endoxan, malphalan, cealysin, trenimon, and mitomycin C. The cytotoxins that produced intermediate effects of about 3 days included methotrexate, purinethol, natulan, actinomycin D, and velbe. The cytotoxins that produced long-term bone marrow depression of more than 6 days included myleran, 5-fluorouracil, and sanamycin. There was no indication of a relation between the sites of action of these cytotoxins and the duration of their effects. With the short-acting combinations of irradiation and cytotoxin it was possible to repeat the combined treatment daily to obtain a longer, more definite depression of the bone marrow. With the combinations that gave long-term responses it was not possible to obtain a more sustained reaction by repeating the dose. In addition, it was found that combinations of 2 cytotoxins that when combined with x irradiation had a short and long action, such as endoxan and fluoro-uracil, gave very prolonged and marked effects on bone marrow. Re-

sults of varying the doses of x irradiation given with the cytotoxins were also reported. (BBB)

34711 AUTO-ALLERGIC REACTIONS FOLLOWING INTERNAL IRRADIATION OF THE LIVER. Wordsworth, O. J.; Dykes, P. W. (Univ. of Birmingham, Eng.). Immunology; 17: 977-90(Dec 1969).

Complement fixation tests using crude liver antigen were carried out on rats following the injection of colloidal ^{198}Au calculated to deliver β radiation doses from 5000 to 10,000 rad. Marked increases in titre were recorded at doses in excess of 5000 rad. Further, tests for total hemolytic complement in ^{198}Au-injected rats at a dose of 8500 rad showed a marked fall in serum complement. Attempts to demonstrate liver fixed γ-globulin and β_{1c}-complement were unsuccessful. Separate groups were then subjected to prior splenectomy or treatment with methotrexate, an immuno-suppressive drug. The development of liver damage was observed in measurements of the serum concentration of transaminase, and complement fixing tissue antibodies, and in the histological appearance of liver biopsies. Animals subjected to splenectomy developed more severe liver damage, whereas in those treated with methotrexate, there was evidence of amelioration of the radiation effect. The significance of these findings is discussed, and it is argued that the results provide some evidence that autoimmune processes contribute to radiation hepatitis. (auth)

34712 HEART REACTIVITY IN IRRADIATED ANIMALS DURING ACUTE HYPOXIA. Akopyan, N. S.; Akopyan, S. A. (Erevan State Univ.). Zh. Eksp. Klin. Med.; 8: No. 4, 26-35(1968). (In Russian).

Changes caused by loss of blood and exposure to x radiation in the reactivity of the heart of animals previously adapted to hypoxia was examined on rabbits. The most unfavorable conditions were represented by removing 24 to 30% of the blood, followed by exposure to 800 R of x radiation. Study of the cardiac reactivity after previous adaptation, bloodletting and irradiation, in comparison with the effect of acute hypoxia revealed that these factors exert a strong action on the functions of the heart. The rhythm of cardiac contractions from acute hypoxia was markedly changed, indicating a serious injury of the regulatory mechanism of the heart; the cardiac activity was also strongly reduced. After adapting the animals to oxygen insufficiency and posthemorrhagic reactions, the sensitivity and the reactivity were increased. The experiments thus indicated that the animals were able to adapt to unfavorable conditions, including ionizing radiations. (TTT)

34713 AN INVERSE RELATIONSHIP BETWEEN ACTIVITY AND RADIATION RESISTANCE IN MICE. Spalding, J. F.; Archuleta, R. F.; Johnson, O. S. (Los Alamos Scientific Lab., N. Mex. Int. J. Radiat. Biol.; 17: 291-2(1970).

Two within-strain sub-lines with different radiation tolerances were developed, and since the RFM stock of origin were inbred for approximately 75 generations, the sub-lines are considered otherwise genetically similar. Eighteen mice from each of the two sub-lines of strain RFM mice and 18 F mice from a cross between the two sub-lines were used. Approximately 2 weeks after activity testing, 54 mice were exposed to ^{60}Co γ rays at a dose-rate of 4.5 rads/hour until they succumbed. The significance of differences between the mean activity and survival times of the three groups was determined by analysis of variance. The activity of the F mice was significantly less than that of the radiosensitive sub-line and significantly greater than that of the radioresistant sub-line. The radioresistance of the F mice was indistinguishable from the radioresistant sub-line. The survival-time data suggested a single locus dominant/recessive effect for radiation resistance, resistance being dominant over sensitivity, and the activity data indicate a single locus effect with the absence of dominance. (UK)

34714 LATE DEVELOPMENT OF PULMONARY LESIONS IN THE RAT AFTER GENERAL IRRADIATION. HISTOCHEMICAL AND ULTRA STRUCTURAL OBSERVATIONS. Caulet, T.; Adnet, J. J.; Legay, G.; Guenet, J. L. (Laboratoire d'Anatomie Pathologique, Reims, France). Int. J. Radiat. Biol.; 17: 269-76 (1970). (In French).

The histological, histochemical and ultrastructural changes observed in the lungs of rats following single exposures in the range of 100 to 800 rads are related; after a delay of 2 to 13 months, an interstitial fibrosis developed; at the same time, enzymatic changes were observed: the positivity of alkaline phosphatases on the interalveolar capillary walls, an increase of acid phosphatases at the level of the alveolar cells, especially the granulous pneumocytes (centers of focal cytolysis); these changes were studied by electron microscopy, by which an elastoid material was detected in the interalveolar wall. Irradiation of the entire lungs of rats, where a super-added injury (exogenous overstress) prevailed, resulted in a sclero-emphysema. (auth) (UK)

Man

Refer also to abstracts 34098, 34108, 34114, 34123, 34128, 34134, 34139, 34142, 34168, 34243, 34244, 34246, 34259, 34268, 34282, 34285, 34320, 34323, 34364, 34372, 34384, 34385, 34389, 34419, 34420, 34424, 34515, 34547, and 34563–34565.

34715 (AD-696445) A STUDY OF THE METABOLIC ASPECTS OF THERAPY OF RADIATION INJURY IN THE SOLDIER. Final Report. (Federation of American Societies for Experimental Biology, Washington, D. C. Life Sciences Research Office). Sep 1969. Contract DADA17-67-C-7180. 159p. CFSTI.

Early symptoms produced by radiation exposure are related to the abnormal physiology and cellular lesions of the gastrointestinal tract. These symptoms have diagnostic value but the pathologic changes are not readily amenable to medical treatment. Recent research on the effects of radiation on the gastrointestinal tract of man and experimental animals is reviewed including: gastrointestinal symptomatology; immediate post-irradiation cellular events; morphologic responses; gastrointestinal and hematopoietic correlations; intestinal motility and malabsorption; intestinal flora changes; antibiotics in radiation therapy; radiation-induced vomiting; transport of fluid, electrolytes, nutrients, and other essential elements; and alterations in drug metabolism. In reviewing these aspects of the radiation-induced "gastrointestinal syndrome" therapeutic opportunities are identified. Suggested areas for future research emphasis are summarized. A critical literature review entitled The Gastrointestinal Syndrome in Acute Radiation Injury and an annotated evaluative bibliography constitute Part II of the report. (auth) (TAB)

34716 (CONF-690335, pp 13-25) BIOEFFECTS OF NON-IONIZING ELECTRONIC PRODUCT RADIATION. Mills, W. A. (Bureau of Radiological Health, Rockville, Md.).

Hazards to human populations from exposure to non-ionizing radiations, including visible light, infrared radiation, laser radiation, microwaves, electromagnetic fields, radio waves, and ultrasound are discussed. The effects of uv radiation on human skin and eyes are reviewed. It is pointed out that the use of these radiations in medicine, industry, and home appliances may present a hazard to personnel and to the general population. (C.H.)

34717 (TID-25431) VISUAL EFFECTS OF IONIZING RADIATION. Schafer, Kenneth L. Jr. (Florida State Univ., Tallahassee. Dept. of Psychology). [nd]. 40p. Dep. CFSTI. Thesis.

Data are reviewed from a number of studies on the effects of ionizing radiation on the visual systems of a number of species including insects, molluscs, and man. The data are compared in an effort to clarify the mechanisms of action of ionizing radiation on known functional aspects of the visual system. It was concluded that there is no good evidence to support the idea that ionizing radiation acts on the visual purple of the eye in a manner analogous to light quanta. The studies of bleaching and energy absorption are simply not clear enough to indicate the nature of the interaction between ionizing radiation and the photopigment. In addition there is clear evidence from the studies of interactions between x ray and light stimuli as backgrounds as well as stimulus pulses to indicate that the mechanisms for the detection of the two stimuli probably differ in basic ways at the receptor level. Theories of fluorescence and energy transfer do not explain the differences between the two effects in a satisfactory manner since it is generally assumed that the final effect of radiation induced fluorescence or energy transfer is to cause normal photoisomerization of the rhodopsin chromophore; so in essence these theories predict the same effect as theories of direct action on the visual pigment. One alternative mechanism for excitation might be the free radicals that are formed by the ionizing radiation. (C.H.)

34718 (STI/PUB-228) RADIATION-INDUCED CANCER. Proceedings Series. Proceedings of a Symposium Held in Athens, 28 April-2 May 1969. (International Atomic Energy Agency, Vienna (Austria)). Nov 1969. 506p. (In French and English). (CONF-690404). IAEA $13.00.

Separate abstracts were prepared for the 36 papers presented at the conference. An author index is included. (H.L.W.)

For abstracts of individual papers see: 34031–34033, 34143, 34241–34246, 34323, 34386, 34387, 34563, 34568, 34569, 34631–34645, and 34719–34723.

34719 CARCINOGENIC EFFECTS OF RADIATION IN MAN: THE IMPORTANCE OF ESTIMATES FOR PROTECTION PURPOSES. Pochin, E. E. (Medical Research Council, London). pp 3-10 of Radiation-Induced Cancer. Vienna; International Atomic Energy Agency (1969).

From Symposium on Radiation-Induced Cancer, Athens, Greece. See STI/PUB-228; CONF-690404.

Problems that need to be solved to determine the quantitative

relationships between low levels of irradiation and the induction of cancers in man are outlined. It is pointed out that a solution to these problems would make possible more reliable recommendations on the levels of both external radiation and radiation from internal sources to which mankind can be subjected without constituting a significant health hazard. (auth)

34720 RADIATION AND NATURAL CARCINOGENESIS. DOES SOMATIC MUTATION PROVIDE A COMMON LINK? Burch, P. R. J. (Univ. of Leeds, Eng.). pp 29-44 of Radiation-Induced Cancer. Vienna; International Atomic Energy Agency (1969).

From Symposium on Radiation-Induced Cancer, Athens, Greece. See STI/PUB-228; CONF-690404.

A theory is briefly outlined of the control of normal growth by a central system. The consequences of this theory for the problem of neoplastic growth are considered: at least three categories of malignant disease can be postulated. By means of onset and death-rate statistics, the sex- and age-distributions of various malignant diseases in man are analyzed. It is proposed that each form of natural neoplasm is initiated by one or more somatic gene mutations in stem cells of the central system of growth control. Changes in target cells leading to carcinoma, for example, probably involve an indirect inductive mechanism. The phenomenon of the local induction of cancer by ionizing radiation implies that peripheral growth control and/or target cells are at mutational risk. If radiation can induce gene changes similar to those that occur naturally, then dose-response relations are expected to be complicated. However, at low dose, this relation should in theory become linear. (auth)

34721 RADIOBIOLOGICAL PARAMETERS IN HUMAN CANCERS ATTRIBUTABLE TO LONG-TERM RADIUM DEPOSITION. Finkel, A. J.; Miller, C. E.; Hasterlik, R. J. (Argonne National Lab., Ill. Argonne Cancer Research Hospital, Chicago). pp 183-202 of Radiation-Induced Cancer. Vienna; International Atomic Energy Agency (1969).

From Symposium on Radiation-Induced Cancer, Athens, Greece. See STI/PUB-228; CONF-690404.

A mixed population of about 300 persons that acquired appreciable body burdens of radium 35 to 50 years ago has been followed by our group for the past 20 years. Radium was acquired by these patients by occupational exposure and from administration orally and intravenously by their physicians. To date, a number of these patients have developed fibrosarcomas and osteogenic sarcomas of skeletal tissues, carcinomas and sarcomas of the mastoids and paranasal sinuses, and serious blood dyscrasias. In many cases, analysis of the exposure history and of contemporary body burdens has enabled us to reconstruct the patterns of radium retention. From these computations, we have been able to analyze the appearance of neoplasms in terms of: contemporary or terminal radium burdens, estimated maximum (i.e., peak initial) radium burdens, and estimated daily and total amounts of radium entering the blood stream during exposure. The ranges of values of these various indices for groups of patients with and without malignant disease and other disabling conditions may serve to characterize the likelihood of radiation carcinogenesis in these and similar patients. (auth)

34722 RADIATION-INDUCED TUMOURS IN MAN. Chisleag, Gh.; Baran, Elena; Petroveanu, C. (Clinic of Radiology, Yassy, Romania). pp 459-67 of Radiation-Induced Cancer. Vienna; International Atomic Energy Agency (1969).

From Symposium on Radiation-Induced Cancer, Athens, Greece. See STI/PUB-228; CONF-690404.

The development of cancer in man, after doses of ionizing radiation for therapeutic purposes, in connection with ten cases of malignant tumors which appeared after x-ray treatment and three cases among the radiological medical personnel, was investigated. Four of the cases concerned skin cancer, which made its appearance after a latent period of 8 to 15 years on the skin of the area which had been irradiated, often for a benign complaint, while five of the cases concerned leukemia (myeloid in two cases, lymphatic in three). They have also studied two cases exhibiting carcinoma of the irradiated soft parts and one case of osteosarcoma. The authors discuss the frequency of x-ray-induced cancers in relation to the frequency of cancerous localizations in general and to that of multiple or associated cancers. They study the role of the type and doses of radiation administered and other radiobiological factors, and also the relationship between the dose and the latent period. Finally, attention is given to the possibilities of prophylaxis. (auth)

34723 INTERNATIONAL ACTIVITIES IN RADIATION-INDUCED CARCINOGENESIS. Komarov, E. (World Health Organization, Geneva). pp 475-8 of Radiation-Induced Cancer. Vienna; International Atomic Energy Agency (1969).

From Symposium on Radiation-Induced Cancer, Athens, Greece. See STI/PUB-228; CONF-690404.

Reports on radioinduced carcinogenesis by IAEA, ICRP, UNSCEAR, and WHO are discussed. Although much attention has been given to animal experiments, information applicable to humans is inadequate. The most important basic question in radiation health at present is the quantitative evaluation of the health hazards from different radionuclides with which man is coming into contact. Although excellent studies on leukemia induced by external radiation, particularly those on survivors of atomic bombing at Hiroshima, are available, the information is by no means complete. An outline is presented for panel discussion of recommendations on radioinduced carcinogenesis. (H.L.W.)

34724 DELAYED CEREBRAL RADIONECROSIS WITH PSEUDO-TUMORAL EVOLUTION. Bernasconi, V.; Giovanelli, M.; Perria, C.; Wildi, E. (Univ., Milan. Univ., Geneva). Minerva Neurochir., 11: 28-41(1967). (In Italian).

Two cases of delayed cerebral radiation necrosis with a pseudotumoral evolution are described. Both patients had extra-cerebral tumors, a craniopharyngioma in the first case and an ethmoido-orbital epithelioma in the second. The histopathological picture observed in these cases is compared with those reported in the literature, with particular regard to the pathogenesis of such lesions and their expansive evolution. The difficulty of a differential diagnosis between recurrences of a neoplasm, metastases of extracerebral tumors and radionecrosis with a pseudotumoral evolution is stressed. (auth)

34725 RADIATION INDUCED CHANGES IN LYMPHOID CELLS. Wedekind, L. V.; Jorke, D. (Staedtische Krankenhaus, Jena, Ger.). Folia Haematol. (Leipzig); 91: 395-405(1969). (In German).

Investigations in 25 patients irradiated therapeutically (4,500 to 6,000 Rad) showed that lymphoid cells of the peripheral blood are not involved in the lymphopenic reaction, but will increase during irradiation. The hitherto described atypical lymphocytes and monocytes after burdening by radiation turn out to be lymphoid cells. Within the subdivisions of lymphoid cells a shifting is produced in favor of the great clear plasmatic lymphoid cells with an increase of their number of nucleols. Blood plasma cells will increase only to a small extent. Moreover, lymphoid cells undergo regressive changes. The behavior of lymphoid cells is considered to be a cellular image of an RHS reaction with cells stimulated and resistant against radiation being washed out. (auth)

34726 MODERN APPROACHES TO THE RADIOTHERAPY OF LYMPHOMA. Johnson, Ralph E. (National Cancer Inst., Bethesda, Md.). Seminars Hematol.; 6: 357-75(Oct 1969).

Complications of irradiation treatment of malignant lymphoma are enumerated in a review of treatment plans used and clinical results obtained in 121 patients. In Hodgkin's disease a minimum tumor dose of 3500 to 4000 Rad delivered in 4 to 6 weeks will result in few primary recurrences within irradiated areas. For patients with Stage I and II involvement, total-nodal irradiation (the systematic irradiation of the cervical, supra- and infraclavicular, axillary, mediastinal, para-aortic, iliac, inguinofemoral, and splenic regions with tumoricidal doses) was used. There was surprisingly good tolerance to total-nodal radiotherapy when treatment was carefully planned to shield maximally normal tissues and administered with the necessary rest intervals between the successive courses of irradiation to different areas. Most of the serious complications were not related to total-nodal irradiation per se, but rather to local irradiation of moderately radiosensitive viscera with fairly intensive doses. Many patients experienced acute gastroenteritis and there were several instances of gastric ulceration. These ulcers, all of which healed with medical management only, were the consequence of radiotherapy field arrangements that produced overdosage in the upper abdomen at the point of treatment field junctions. One patient developed an esophageal stricture that required dilatation for several months. Several patients also experienced the delayed onset of moderate soft tissue fibrosis especially in the shoulder girdle region. The most severe complication was radiation pericarditis with effusion; 9 patients required pericardiectomy for pericardial effusion. The complication was related in part to the use of anterior mediastinal treatment portals only, rather than parallel opposing fields and to the use of unnecessarily intensive (1000-Rad tumor dose per week in 5 fractions) radiation dose schedules. With greater dose fractionation (200 Rad given 4 times weekly) and parallel opposing mediastinal fields, clinically detectable effusions were not observed. (BBB)

34727 THERAPY OF LYMPHOMA. Ultmann, John E.; Nixon, Daniel D. (Argonne Cancer Research Hospital, Ill.). Seminars Hematol.; 6: 376-403(Oct 1969).

Side effects of radiotherapy of Hodgkin's disease and other lymphomas are reported. Half of patients with Stage III A Hodgkin's disease treated with radiotherapy undergo prolonged unmaintained remissions. Patients with widespread lymphocytic lymphosarcoma

limited to lymph nodes (Stage III) may receive irradiation in an attempt at tumor eradication despite early visceral involvement, since the radiosensitivity of this neoplasm permits tumoricidal irradiation to large fields without severe toxicity. Reticulum cell sarcoma which spreads unpredictably, involves parenchymal organs early, and is relatively radioresistant, is usually best treated with chemotherapy when nodal disease is extensive. Although the results of aggressive, extended-field irradiation are encouraging, the disadvantages of these programs must be considered. The duration of therapy is several months and, during much of the period, the patient experiences radiation sickness. Occasionally, damage to the heart, lungs, kidneys, or great vessels occurs and as well as fatalities from these complications. The effects of pelvic and vertebral irradiation upon bone marrow function must be considered. Although granulocyte reserves replenish themselves within 6 months and full tolerance to chemotherapy is eventually restored, there is a period of several months following irradiation when chemotherapy may produce severe marrow hypoplasia. In some patients, this marrow hypoplasia persists for longer than 6 months.

34728 THE CHANGES OF THE PERIPHERAL BLOOD-PICTURE OF PATIENTS WITH GYNECOLOGICAL TUMOURS, AFTER RADIATION TREATMENT. Tordy, B. Magy. Radiol.; 21: 158-62(Jun 1969). (In Hungarian).

From data obtained on 160 patients, it was concluded that the peripheral blood picture changed considerably after the administration of 4,000 to 6,000 R of irradiation. Data found in the literature correspond to these results. It is suggested that the change is partly due to the great volume dose. The danger of bone marrow injury, concomitant with the simultaneous use of cytostatic drugs, is pointed out and possibilities for the prevention of hematologic crisis are given. (C.O.)

34729 POSTIRRADIATION FRACTURES OF THE NECK OF THE FEMUR. Bruszewski, Janusz; Lempicki, Andrzej (Academy of Medicine, Poznan, Poland). Chir. Narzadow Ruchu Ortoped. Pol.; 32: 689-96(1967). (In Polish).

Six cases of irradiation fractures of the neck of femur that occurred in 5 patients are reported and a review of literature referring to 93 fractures of the same type in 80 patients is presented. The incidence of femoral fracture following radiotherapy for gynecologic tumors varied from 0.1 to 3.2%. Microscopic findings and radiologic features were discussed. The histologic study of the involved bone showed an adequate circulation for fracture healing. Attention was called to the importance of early diagnosis. The characteristic roentgenologic findings and the possibility of bone union after early operative reduction are considered. One case of fracture of the neck of femur in a female patient aged 45 is described in detail and the microscopic changes cited. In this case a castrating dose of radiation had been given. (BBB)

34730 ANGIORGRAPHIC DETECTION OF A PSEUDOCYST FOLLOWING RADIOGOLD THERAPY FOR CARCINOMAS OF THE OVARY. Vahrson, Helmut; Steckenmesser, Rainer (Univ., Giessen, Ger.). Strahlentherapie; 139: 167-73(Feb 1970). (In German).

It was reported that a pseudocyst appeared ten years after ^{198}Au therapy of an ovarial carcinoma of group II b and was interpreted as a late complication following the preceding therapy. Final proof of this pseudocyst was roentgenologically established by gastrocolonic passage and by angiography; the proof was histologically secured. (auth)

34731 RADIATION-INDUCED BREAST CANCER. Tarnplin, A. R.; Gofman, J. W. Lancet; 1: 297(7 Feb 1970).

The incidence of breast cancer is discussed in women who have been exposed to x rays during fluoroscopic control of pneumothorax therapy for pulmonary tuberculosis. It was concluded that radiation carcinogenesis occurs in proportion to the spontaneous incidence of cancer in a given tissue, i.e., the dose required to double the incidence of cancer in one organ doubles the incidence in other tissues. Indications were that over the dose range of 40 to 300 rads, the dose required to double the incidence of spontaneous breast cancer is approximately 20 rads. It was suggested that if there are enough fluoroscopy records it may be possible to describe the dose-response curve for radiation induction of breast cancer for a wide range of doses. (UK)

34732 MULTIPLE PAGET-LIKE EPITHELIOMAS IN AN AREA TREATED PREVIOUSLY BY LARGE DOSES OF X RAY IRRADIATION. Colomb, D.; David, D. Lyon Med.; 220: 1857 (1968). (In French).

A report is given on a woman of 62 yrs of age, which raised the problem of impairment of the skin by radiotherapy more than 20 yrs earlier, in the absence of radiodermatitis (except for the first epithelioma treated). It seems that in the case reported this etiology should be taken into account in view of the elective localization of the epithelioma in the lumbosacral region. Examination did not reveal an epithelioma of other localization. (Excerpta Med.)

34733 INCREASED FORMATION OF HEINZ BODIES IN THE ERYTHROCYTES FOLLOWING RADIATION EXPOSURE. Gerhardt, Paul (Univ., Tuebingen, Ger.). Strahlenschutz Forsch. Prax.; 7: 307-9(1967). (In German).

The counting of Heinz inclusion bodies in erythrocytes was used for evaluating radiation exposure at the radiology institute in Tuebingen. An increase was found in 96 people professionally handling radiation, in patients who underwent radiotherapy, and in rabbits exposed to daily doses in excess of 200 mr. To assess the diagnostic value of the procedure, large scale studies are suggested. (H.B.G.)

34734 CANCER DUE TO RADIOACTIVE HOME-REMEDIES. Born, Willi (Univ., Freiburg i. B.). Strahlenschutz Forsch. Prax.; 7: 323-36(1967). (In German).

Until recently, radium-containing compresses, pillows, and drinking beakers were advertised by non-medical sources as a cure for a variety of diseases. Since 1954, the number of people who developed skin carcinoma in the treated area increased markedly. Several new cases were observed at the department of dermatology at Freiburg university. Obviously, continuous low radiation over a period of 6 to eighteen years can induce cancer in a significant number of cases. Various types of the equipment as well as the drastic consequences of their use are depicted. (H.B.G.)

34735 CLINICAL EPIDEMIOLOGY OF LEUKEMIA. Fraumeni, Joseph F. Jr. (National Cancer Inst., Bethesda, Md.). Seminars Hematol.; 6: 250-60(Jul 1969).

Recent clinical-epidemiologic developments based on information obtained from single cases to large populations, that have provided some insight into irradiation as an etiologic factor in leukemia, were reviewed. A recent downturn in leukemia mortality has been reported for the U.S. white population, especially in young children. The trend may have been due to diminished exposure to medical x rays. From follow-up studies of patients that received partial-body radiation for treatment of ankylosing spondylitis, and 20-yr survivors of the atomic blasts in Hiroshima and Nagasaki, that showed excessive rates for acute leukemia, radiation in sufficiently high doses was shown to cause chronic myelogenous leukemia and acute leukemia. The highest risk of leukemia was found among polycythemia vera patients that were treated with x rays, ^{32}P, or both. In these patients the frequency of leukemia is 16% within 10 to 15 yr. The leukemia may result from the interaction of irradiation with a disease that is intrinsically susceptible, on the basis of its myeloproliferative character or chromosomal aneuploidy. Preconceptional diagnostic irradiation of parents increased the risk of leukemia among children conceived after exposure. A study of 319 children showed a relative risk of 1.6 and 1.3, respectively, following irradiation exposure of future mothers or fathers. In contrast, a study of 17,700 children by the Atomic Bomb Casualty Commission showed no increase in leukemia after much heavier exposure of their parents to preconceptional radiation, and there was no excess of chromosomal abnormalities among children conceived at various intervals after the mothers or fathers were exposed to the atomic blast. The lack of consistency and specificity of effect suggested that the association between preconceptional radiation and leukemia was not causal, but resulted from some aspect of the underlying state that required radiologic examination. Diagnostic irradiation during pregnancy may double the risk of childhood leukemia. However, the magnitude of the association has suggested lack of specificity, since in utero exposure is associated with equally increased rates for each childhood neoplasm other than leukemia. A dose-response relation characteristic of radiogenic leukemia was indicated by an excess of leukemia in a limited sample of women receiving castrating doses of pelvic irradiation for metropathia hemorrhagica, but no increase in risk was observed among women that received much larger doses of irradiation for treatment of cervical cancer. These findings suggested that under conditions of intense localized irradiation, the marrow cells may have less capacity for transformation than when more lightly exposured. (BBB)

34736 HEPATIC INJURY FOLLOWING IRRADIATION. Lidgren, Lars (Allmanna Sjukhusets, Malmo, Sweden). Nord. Med.; 83: 242-4(1970). (In Swedish).

The histological changes of the liver in an irradiated patient with a seminoma are discussed. Some groups in which the liver is exposed to great risk of irradiation were investigated. The typical histological change after irradiation with doses exceeding

4000 rad for a period of less than 3 to 4 weeks, was hepatic venous obstruction at the lobular level. The reported changes support the opinion that the liver is more radiosensitive than previously believed, which is of interest in the more wide-spread irradiation for Hodgkin's disease among others. (auth) (Sweden)

34737 DELAYED RADIATION NECROSIS OF THE HYPOTHALAMUS: REPORT OF A CASE SIMULATING RECURRENT CRANIOPHARYNGIOMA. Ghatak, Nitya R.; White, Barry E. (Montefiore Hospital and Medical Center, Bronx, N. Y.). Arch. Neurol.; 21: 425-30(Oct 1969).

A case of radiation necrosis of the hypothalamus and optic chiasm following surgical and radiation therapy for a craniopharyngioma is described. Terminal endocrinological and neurological manifestations were clinically ascribed to recurrent craniopharyngioma. The pathological changes in the brain of this patient illustrate the significance of the vascular alterations in the production of delayed radiation necrosis. Four weeks after surgery, radiotherapy was commenced with a 33-MeV betatron beam, and a total dose of 7995 rad was delivered to the pituitary region via a 5 × 4 cm field employing anterior rotation in 28 divided doses given in 70 days. Visual acuity improved but 4 months following the completion of radiotherapy, the onset of progressive fatigability was noted, associated with polydipsia, polyuria, and nocturia. At autopsy the most significant pathologic changes were seen in the sections of the hypothalamus, optic nerves, chiasm, and tracts. There was necrosis of brain tissue varying from total necrosis with neutrophilic cellular response to mild reactive astrocytosis with incomplete loss of neurons. Gray and white matter were equally involved. Arteries of small and medium caliber, in and around the lesions, showed marked alterations consisting of irregular thickening of the walls with fibrosis and fibrinoid necrosis, resulting in narrowing or occlusion of the lumens, sometimes by superimposed thrombi. Severe vascular changes, often with occlusion of the lumens, were constantly associated with necrosis of the parenchyma, whereas brain tissue around less severely affected vessels showed neuronal loss and reactive astrocytosis without destruction of the parenchyma. The results show that an area of delayed radiation necrosis of the brain may closely resemble a tumor, clinically, radiographically, and even macroscopically at the time of surgery. Panhypopituitarism and recurrent visual impairment in the present case were clinically assumed to be due to a recurrent craniopharyngioma that was absent at autopsy. (BBB)

34738 LATE CONSEQUENCES OF EARLY SKIN REACTIONS. Chu, Florence C. H.; Glicksman, Arvin S.; Nickson, James J. (Memorial Hospital for Cancer and Allied Diseases, New York). Radiology; 94: 669-72(Mar 1970).

Re-evaluation of 29 of 85 patients originally categorized quantitatively as to the extent of skin reaction following a standardized 250 kVp x irradiation treatment regimen was carried out approximately ten years later, using essentially the same objective criteria. No apparent relationship between the severity of the initial skin reaction and the late changes was noted. Early and late adverse skin reactions appear to be independently variable. This was true for all skin colors and complexions. Thus, the degree of early reactions to irradiation does not predict later consequences. (auth)

34739 EFFECT OF LASER RADIATION ON THE NECK TISSUE OF ALBINO RATS, ON TUMORS REMOVED FROM PATIENTS, AND ON THE INOCULATED CELL CULTURES OF LARYNGEAL CANCER. II. Kolomiichenko, A. I.; Pokotilenko, A. K.; Timen, G. E.; Lapko, A. E. Zh. Ushnykh Nosovykh Gorlovykh Bolez.; 29: 28-35(May-Jun 1969). (In Russian).

Morphological data are presented indicating the destructive effect of the rays of ruby and neodymium lasers on the skin and muscles of the neck, the cartilages and mucous membrane of the larynx, and also on the inoculated culture of cells of cancer of the larynx and tumors removed in patients during biopsy or operations. The results obtained from chronic experiments are evidence of the dependence of the destructive effect on the power and number of pulses. It is interesting to note that the structures located outside the zone of direct action of the ray possess potential for multiplication and growth. At the same time cells injured by radiation undergo alterations with time that are incompatible with life, which opens up promise of applying lasers in the composite treatment of some tumorous diseases of the throat, ears and nose. (auth)

34740 PRELIMINARY RESEARCH ON SOME BLOOD CYTOENZYMOCHEMICAL CHANGES CAUSED BY POST-THERAPEUTIC INTERNAL CONTAMINEATION WITH RADIOACTIVE ISOTOPES. Micu, D.; Niculescou-Zinca, D.; Raiciulescu, N.; Necula, Mariana (N. Gh. Lupu Institutul de Medicina Interna, Bucharest). Stud, Cercet Med. Intern.; 10: 327-34(1969). (In Rumanian).

The 21 patients studied had different forms of thyroid adenocarcinoma and were treated with variable doses of ^{131}I. According to the amount of blood-rads, the patients were divided into three groups. The blood leukocyte count was investigated morphologically and enzymochemically at various time intervals. Lymphopenia remained constant only in the first two weeks, the lymphocyte glycogenic score was generally low and the high granulocyte alkaline phosphatase might be an indication on the state of reactivity of the organism. (auth)

34741 STATE OF MINERAL AND PROTEIN METABOLISM IN THE BLOOD SERUM OF CANCER PATIENTS IN VARIOUS TYPES OF FRACTIONATION DURING RADIATION THERAPY. Ulybaeva, R. K.; Mustafina, R. Kh. (Inst. of Oncology and Radiology, Alma-Ata, USSR). Tr. Kaz. Nauch.-Issled. Inst. Onkol. Radiol.; 6: 266-70(1969). (In Russian).

The content of potassium, sodium, and proteins in serum of oesophageal and lung cancer patients was determined before, during, and after radiotherapy. X radiation was administered in fractionated doses of 700 to 800 R and single doses of 400 R. It was found that the 700 and 800 R dose fractions caused a decrease of albumin and γ globulin fractions in patients with oesophageal cancer. At the end of the treatment there was an increased potassium content but no change in sodium content. No significant changes were found in proteins or minerals of lung cancer patients. (auth)

34742 LATE RADIONECROSIS. Becher, M.; Dietzmann, K.; Koch, R.-D. (Medizinische Akademie, Madgeburg, Ger.). Zentralbl. Allgem. Pathol. Pathol. Anat.; 112: 482-91(1969). (In German).

The case history of one fourteen year old boy was presented. At surgery, an inoperable glioma-type tumor was found. X-ray therapy was performed with approximately 5000 rads to the tumor area. Following therapy, neurological signs increased and the patient died three months later. At autopsy, no remaining tumor was found; however, extensive necrosis of the white matter in both hemispheres was present. Both macroscopic and histological findings of the brain were described. (H.B.G.)

34743 PRENATAL RADIATION DAMAGE OF THE BONE SYSTEM BY IONIZING RADIATION. Szanto, D. (Semmelweis-Komitatskrankenhaus, Miskolc, Hungary). Fortschr. Geb. Roentgenstr. Nuklearmed.; 110: 886-9(1969). (In German).

The simultaneous occurrence of myeloid leukemia and dysplasia osteochondrotica in a seven-year-old child is described. This is considered a direct result of pre-natal damage of the maternal gonads from radio-diagnostic investigations. (auth)

34744 STUDIES ON RADIATION INJURY OF BONE, OR OSTEORADIONECROSIS IN ORAL CAVITY. PART 1. ITS INCIDENCE AND ROENTGENOLOGICAL FINDINGS. Okuyama, Takeo; Horiuchi, Junichi (Tokyo Medical and Dental Univ.). Jap. J. Clin. Radiol.; 14: 472-81(Jun 1969). (In Japanese).

About 240 cases of oral cavity cancer were subjected to the radiotherapy for 10 years between 1955 and 1965, and of these, 149 cases survived more than 1 year after treatment. Radiation injury of the mandible was studied in these cases, and the following results were obtained. Incidence of osteoradionecrosis was 13% of the total cancers of oral cavity, and was 33% of cancers of the mandible and floor of mouth. As x-ray findings of bone destruction due to irradiation, irregular osteosclerotic figures were seen in osteoclastic changes, and also a fairly intensive osteosclerosis was observed around the osteoclastic changes. It is supposed that mottled osteolytic figures in these lesions are caused by bacterial infection. No periostosis was found, and as initial changes, osteoporotic changes at the top of alveolar bone, retraction of alveolar bone, disappearance of linea alba were observed. As x-ray findings of bone destruction by tumor invasion, osteolysis was the chief change, and osteosclerotic figures around the osteolytic lesions were rarely found. No periostosis was observed. Bone fragments were frequently seen in osteolytic lesions. Roentgenological findings in case of combined recurrence of tumor with radiation injury were mixed patterns of the above mentioned two. Secondary infection and trauma seem to play some important role for provoking osteoradionecrosis. At the present time, the generally accepted treatment of this lesion is to wait for the separation of sequestrum and then to extirpate it, and there is as yet no positive treatment. (NSA of Japan)

34745 THERAPEUTIC PROBLEMS OF LATE INJURIES IN THE NECK REGION FOLLOWING THOROTRAST ADMINISTRATION. von Westernhagen, B.; Hoffmann, B. (Univ., Goettingen, Ger.). HNO; 18: 71-2(Mar 1970). (In German).

The case history of a patient is given who received thorotrast for cerebral angiography twenty years prior to the appearance of

a granuloma extending from the mediastinum to the mandibula. During surgery, the tumor appeared as a hard connective tissue formation containing an abscess. Histology revealed no malignancy: the abscess content proved sterile. (H.B.G.)

34746 RADIATION BURDEN DURING USE OF ^{113}In FOR PLACENTOGRAPHY. Wuerthner, K. L.; Leven, H.; Graesslin, D. (Univ., Hamburg). Frotschr. Geb. Roentgenstr. Nuklearmed.; 112: 478-85(Apr 1970). (In German).

From measurements of excretion and placental transfer of the isotope ^{113m}In the radiation dose for mother and fetus were calculated when ^{113m}In was used for placentography. The average for the mother was 19 mrad, for maternal blood 83 mrad, and for the fetus 8 mrad. The dose to the fetus was negligibly small compared with the maximal values recommended by the I.C.R.P. (1 mrad). (auth)

Radiation Effects on Plants

Refer also to abstracts 34029, 34109, 34125, 34133, 34136, 34137, 34239, 34240, 34247, 34252, 34253–34256, 34262, 34267, 34269, 34272, 34273, 34275, 34277, 34279, 34283, 34284, 34290, 34291, 34293, 34294, 34321, 34704, and 34786.

34747 EFFECT OF ULTRA-HIGH DOSE-RATE β-RAY IRRADIATION IN AEROBIC AND HYPOXIC CONDITIONS ON THE SURVIVAL OF DIPLOID YEAST. Kiefer, J.; Ebert, M. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Biophysik; 6: 271-4(1970).

Diploid yeast cells of Saccharomyces cerevisiae grown to stationary phase in air-bubbled suspensions of a synthetic medium (glucose as C source and asparagine as N_2 base) were exposed to single μsec pulses of 12-MeV electrons at dose rates up to 3×10^{10} Rad/s. Cells were irradiated in aqueous suspensions as 1 ml samples in small glass tubes after being pregassed with either pure O_2 or N_2 for at least 15 min; tubes were sealed immediately before irradiation. Doses were varied either by changing the machine current or by changing the pulse length (5 μsec to 100 nsec) and were measured by ferrous sulfate dosimetry and corrected for dose rate effects. No difference in surviving fractions was found with total doses up to about 150 kRad as compared to exposures at conventional dose rates. (C.O.)

34748 TECHNIQUES OF MAKING SHORT-TERM TISSUE CULTURES OF POTATO TUBERS. II. EFFECT OF SOME EXOGENOUS AND ENDOGENOUS FACTORS ON THE GROWTH. Faludi, B. (Eoetvoes Univ., Budapest). Acta Agron. Acad. Sci. Hung.; 17: No. 1-2, 71-81(1968).

In making tissue cultures of potato tubers the pH of the environment should be kept close to that of the tissues. The cultures will grow properly only in the dark. The optimum temperature was found to be 23 to 26°C. Irradiation of the tubers with γ rays decreases by 40 to 60% the effect of 2,4-D used in optimum concentration. The inhibitory effect depends more on the time of irradiation than on the increase of the dosage in the range of 10 to 80 kR. Direct irradiation of tissue cultures revealed that at the time of an intensive stimulation of growth only very high radiation doses are able to inhibit the stimulatory effect of 2,4-D. The optimum weight to start with was found to be near 25 g. This value was obtained in either of two ways: by increasing the section thickness or the area. Both the section thickness and area were found to be of significance. The best results are obtained by using a section thickness of 670 μ and an area of 5×5 mm. The use of inappropriate sizes will result not only in a decrease of the growth index and in unfavorable percentages of variation but also in the occurrence of demarcation phenomena near the optimum size. Tissue growth is influenced also by the date of storage to different extents depending on whether 2,4-D was applied in suboptimum, optimum or growth inhibiting concentrations. When the optimum concentration of 2,4-D is used the ease with which stimulation can be effected is least at the beginning and at the end of the storage period. (auth)

34749 CROSS-FERTILITY OF KUMOTOOSI POLLEN, CRYPTOMERIA JAPONICA D. DON, AFTER ACUTE OR CHRONIC GAMMA IRRADIATION AND HEIGHT GROWTH OF THE SEEDLINGS. Oba, Kihachiro (Inst. of Radiation Breeding, Ibaraki, Japan); Sugimura, Giichi. Nippon Ringaku Kaishi; 51: 340-4 (Dec 1969). (In Japanese).

Pollen at a Sugi clone, Kumotoosi, Cryptomeria japonica, irradiated with γ rays from a cobalt-60 source acutely or chronically was pollinated to nonirradiated female strobili of Kuma-sugi at the Institute of Radiation Breeding in 1965. To force flowering, gibberellin solution of 200 ppM was sprayed on trees in July 1964. For acute irradiation, the pollen was collected from cut-branches with mature male strobili, and exposures of 1.0×10^3, 2.0×10^3, 3.4×10^3 and 5.9×10^3 R were delivered by 20 hour-irradiation. Chronically irradiated pollen was collected from cut branches with male strobili of Kumotoosi that had been grown in the γ field since 1962. Chronic exposure rates per day (20 h) were 1.54, 5.02, 7.33 and 10.0 R on October 1, 1964. Total exposures for the trees in term of plantation to pollen collection were estimated to be 1.5×10^3, 5×10^3, 8×10^3 and 11×10^3 R and those for pollen formation were also estimated to be 0.3×10^3, 1.0×10^3, 1.4×10^3, and 2.0×10^3 R at respective exposure rates. No stimulative effect of irradiated pollen was noted on seed production, germination and height growth of one- and two-year-old seedlings. In acute irradiation, LD_{100} for seed germination was estimated to be 7×10^3 R and exposure that would result in 50% reduction of germination was 3 to 4×10^3 R. Under chronic irradiation, lethal daily exposure for sugi was about 10 R, while germination percentage of the seeds pollinated with the chronically irradiated pollen at 10 R/day was reduced to one third of the control. By comparison of seed germination percentage between acute and chronic irradiation, equivalently effective acute exposures for chronic pollen irradiation were estimated to be 1.7×10^2 R to 5.02 R/day, 2.7×10^3 R to 7.33 R/day and 4.8×10^3 R to 10.0 R/day respectively. It indicates an injurious effect of pollen on seed germination with accumulated exposure of the trees. (NSA of Japan)

34750 HISTOLOGICAL STUDIES OF GAMMA IRRADIATION ARTICHOKE HEADS. Wali, Y. A. (Ein Shams Univ., Cairo); Abdel-Salam, A. S. J. Amer. Soc. Hort. Sci.; 94: 507-9(1969).

The effect of ionizing radiation (10 to 100 kR of gamma rays) on cells of mature artichoke heads was studied. Spongy parenchyma cells of outer bracts separated following radiation and ruptured as the dose increased. The number of parenchyma cells increased with 10 kR treatment but decreased with doses higher than that. Following doses of 10 kR to the edible portion, some xylem vessels were blocked. (auth)

34751 ULTRASTRUCTURAL CHANGES IN ULVA-LACTUCA LINNAEUS AFTER EXPOSURE TO RUBY OR NEODYMIUM LASER RADIATION: A PRELIMINARY REPORT. Rajamaran, R.; Kamra, Om P. (Dalhousie Univ., Halifax, Nova Scotia). J. Ultrastruct. Res.; 29: 430-7(1969).

Response of cellular organelle in Ulva lactuca Linnaeus to unfocused ruby (6943 Å) and neodymium (10,900 Å) lasers has been studied. The ultrastructural changes were restricted mainly to the chloroplast and the Golgi system. The damage was extensive and considered to be irreversible after exposure to ruby laser, while it was minimal after exposure to neodymium laser. The damage to the chloroplast is considered to be due to the absorbing efficiency at the given wavelengths. The dilation of the dictyosomal cisternae indicates the high sensitivity of the Golgi system to cellular injury. (auth)

34752 THE EFFECTS OF GAMMA IRRADIATION ON SOME TECHNOLOGICAL CHARACTERISTICS OF MAIZE FOR STARCH PRODUCTION. A COMPARISON TO DRYING BY HIGH TEMPERATURES. Saint-Lebe, Louis. (CEN de Cadarache, Saint-Paul, France). Staerke; 21: 8-13(Jan 1970). (In French).

Drying by high temperature of moist maize was compared to gamma irradiation with subsequent long time drying by aeration with only slightly heated air. A comparison was made between the effect of irradiation with ^{60}Co and the classic drying on technological characteristics of maize for starch industry. Irradiation of the moist corn had, at least up to 400 kRad, no effect on the industrial extraction process of starch, and no influence on the sensitivity of starches in their native form against α-amylase was found. Irradiation facilitates gelatinization of starch and the viscosity maximum of the paste is lowered simultaneously (25% at 200 kRad). These changes have a relation to the irradiation dose and were attributed to a depolymerization of the starch molecule on the one hand and to a weakening of the grain hull on the other hand. The depressive effect is decreased to a minimum by the preceding conditioning; thus the decrease of viscosity at 200 kRad after 14 days of non-drying aeration is only 8%. The effects of hot-air drying were stronger and irreversible; the inner and the outer hull of the starch granule are affected, which is indicated by a decrease of the viscosity maximum of the pastes (22% at 74°C). The important quality features of maize and maize starch remained unaltered by irradiation of 200 kRad a dose that was reserved for the treatment in question. (auth)

34753 GAMMA IRRADIATION OF WHEAT. Pukhal'skii, A. V.; Maksimov, I. L. Vestn. Sel'skokhoz. Nauki (Moscow); No. 7, 42-6(1969). (In Russian).

The acute gamma-radiation of eight spring wheat species at the tillering stage at the doses from 6.6 to 38.2 kR shows that doses for such treatment should not exceed 10 to 15 kR. The radiation doses depend on species, variety, and meteorological conditions. (auth)

34754 CYTOGENETIC STUDIES IN RAUVOLFIA SERPENTINA (L.) BENTH. EX-KURZ. Torne, S. G. Bombay; Univ. of Bombay (1968).

Thesis.

The somatic chromosome number in the diploid is 22 and in the colchicine induced and naturally occurring tetraploid it is 44. Detailed karyotype and meiotic analyses were made in these plants. An increase of 11% in total alkaloid content was observed in the tetraploid roots. Seeds were irradiated with 250R to 30,000R doses of gamma rays, and three generations were studied. Development of seed of the diploid and tetraploid plants were worked out. (Indian Sci. Abstr.)

34755 A CYTOGENETICAL STUDY OF THE EFFECTS OF X RADIATION ON THE BURLEY VARIETY OF NICOTIANA TABACUM LINN. Mukhopadhyay, Debdas. Lexington, Ky.; Univ. of Kentucky (1962). 116p.

Thesis.

Soaked seeds of burley variety of Nicotiana tabacum Linn. were irradiated in a Keleket x-ray machine operated at 189 kV and 15 mA. The dosages given ranged from 500 to 2000 and 5000 R. The effects of x radiation were observed first by noting the percentage and rate of germination of the seeds and the rate of growth of the seedlings. A series of highly fluctuating and unstable morphological alterations could be observed in plants in 1500 R, 2000 R and 5000 R treatments. The most marked alterations in 2000 R and 5000 R treatments were bifurcation of the stem and production of deformed leaves. A few plants in the 1500 R treatment had chlorophyll deficient areas on the leaves and stem. Flowers in some plants of the 1500 R, 2000 R and 5000 R treatments showed different shapes and shades in color of the corolla. Excepting the chlorophyll-deficient character of leaves and stem no other types of variant characters were found to be carried over to the X_2 generation. It has been suggested that the production of the chlorophyll-deficient character of the leaves and stem was due to somatic gene mutation instead of some temporary change of the plastids. Even those treated plants in the X_1 generation that were recorded as normal, however, had not all escaped the effects of irradiation, as was shown by structural chromosome alterations. Various types of chromosomal abnormalities such as fragments and bridge formation were noted. Fragments both centric and acentric were found from metaphase I to late telophase II in pollen mother cells. These morphological and functional alterations of chromosomes lead to an increase in sterility that could be determined by noting the increase in the percentage of sterile pollen grains. (TSS) (Diss. Abstr. Int., B)

34756 RECONSIDERATION OF THE PROPERTIES OF A PULSED RUBY LASER IN RELATION TO MICROSURGERY. Rajaraman, R.; Kamra, Om P. (Dalhousie Univ., Halifax, Nova Scotia). Photochem. Photobiol.; 11: 121-9(Feb 1970).

The properties of a pulsed ruby laser beam focused through a triocular microscope were studied in relation to microsurgery. Quantitative studies on "model tissues" with different absorbencies at 6943 Å revealed that the spot diameter of the focused microbeam was dependent upon several factors. It decreased with a decrease in the absorption by the object at 6493 Å; a decrease in the energy of the microbeam; and an increase in the magnification of the microscope. The existence of the tube of effect in the optical path of the focused microbeam was realized by irradiating the object at different planes. The depth of the tube of effect increased with increase in laser energy or decrease in magnification. By employing certain plant species (Spirogyra praetensis Transeau, Ulva lactuca Linnaeus, Porphyra miniata (Lyngbye) C. Agardh and Elodea sp.) the reaction of the protoplasm to the laser microbeam in terms of primary damage and secondary damage was defined. Based on these experimental data the concept of minimal visible spot size in laser microsurgery and its limitations are discussed. (auth) (UK)

34757 CHLORELLA, A RADIOBIOLOGICAL MATERIAL. Ozenda, P. (Univ., Grenoble, France. CEA, Grenoble, France). Bull. Inform. Sci. Tech. (Paris); No. 145, 49-52(Feb 1970). (In French).

A brief account is given of the abilities of chlorophyllian microorganisms in radiobiology and of the work carried out on this living material at the Biology Laboratory of the Grenoble Nuclear Center. (France)

34758 RADIOSENSITIVITY OF CHLORELLA TO ALPHA PARTICLES. Roux, J. C. (CEA, Grenoble, France). Bull. Inform. Sci. Tech. (Paris); No. 145, 61-6(Feb 1970). (In French).

The radiosensitivity of Chlorella to ^{210}Po α particles with linear energy transfer (LET) varying from 113 keV/μ to 240 keV/μ is studied. The influence of LET, the interaction of γ rays and α particles, the oxygen effect and the splitting of the dose are investigated. The results are explained in terms of spatial distribution of the absorbed energy. (France)

34759 EFFECT OF ^{60}Co GAMMA IRRADIATION ON THE SURVIVAL OF SOME FUNGI IN SINGLE SAMPLES OF EACH OF THREE DIFFERENT GRADES OF WHEAT. Mohyuddin, M.; Skoropad, W. P. (Univ. of Alberta, Edmonton). Can. J. Bot.; 48: 217-19(Feb 1970).

Wheat grains of grades No. 1, 2, 3 Northern were treated with 100, 300, 500, 700, or 1000 krad of ^{60}Co gamma irradiation to study its effect on the fungi present. Species of Alternaria and Fusarium were abundant, and were highly resistant to irradiation in situ, requiring 1000 krad for complete inactivation. Species of Aspergillus, Rhizopus, and Absidia were less frequently isolated from the grain, and were less resistant to inactivation by irradiation. A dose of 300 krad was required to completely eliminate these fungi. The grade of grain did not affect the survival behavior of various fungi after treatment with gamma irradiation. Increasing doses of gamma irradiation interfered progressively with the formation of septa in the spores of Alternaria sp., and, at a dose of 700 krad, spores failed to form. (auth) (Canada)

34760 DNA SYNTHESIS AND CHANGES IN RADIOSENSITIVITY DURING THE CELL CYCLE OF VEGETATIVE CULTURE OF CHLAMYDOMONAS REINHARDII. Cechacek, Z.; Hillova, J. (Czechoslovak Academy of Sciences, Brno). Int. J. Radiat. Biol.; 17: 127-34(1970).

Vegetatively growing Chlamydomonas reinhardii cells, synchronized by the 12-hour light–12-hour dark cycle, synthesized their DNA between the fourteenth and twentieth hours of the 24-hour cell cycle. Synthesis of DNA preceded nuclear division and the maximum DNA per cell was reached in the seventeenth hour of the cell cycle. The amount of DNA per cell was 2.6×10^{-7} μg. The radioresistance throughout the cell cycle and its relation to DNA synthesis were studied. A 35 per cent increase of D_0 values of the survival curves following x irradiation was found during DNA synthesis. Simultaneously, the extrapolation numbers n changed in indirect proportion to the D_0 values. The shoulder of the survival curve nearly ceased in the seventeenth hour of the cell cycle; however, after the daughter cells had been released from the mother cell, the shoulder was fully restored. The possible role of the repair process and the changes of the target itself in the increase of radioresistance are discussed. (auth) (UK)

34761 RADIOSENSITIVENESS OF INTERSPECIFIC TOBACCO HYBRIDS. Palakarcheva, Mariya (Inst. of Genetics and Plant Breeding, Sofia). Genet. Selektsiya; 2: No. 1, 55-62 (1969). (In Bulgarian).

The radiosensitivity of interspecific tobacco hybrids was investigated to determine stimulating and injuring doses of ^{137}Cs and ^{60}Co γ rays judged by cytological characteristics. Seed was used from interspecific tobacco hybrids produced by crossing oriental tobaccos with the wild species Nicotiana debneyi, resistant to a series of diseases. Seeds from the hybrids and initial species N. tabacum and N. debneyi were irradiated with ^{137}Cs γ rays in doses of 3 and 10 kR and ^{60}Co γ rays in doses of 3, 10 and 20 kR. Mitotic activity of the cells, quantity and type of chromosome aberrations were determined in all treatments. Chromosome aberrations were accounted by the anaphase method. Unirradiated seeds from the hybrids, N. tabacum variety and the wild species N. debneyi were used for comparison. It was shown that a dose of 3 kR stimulates the mitotic activity of the hybrids and variety. Highest radiosensitivity determined by frequency of chromosome aberrations, was found in the amphidiploid N. tabacum × N. debneyi (2n = 96), and in the wild species N. debneyi (2n = 48), followed by N. tabacum and the hybrid (Djebel Bassma 359 × N. debneyi) × Djebel Bassma 359 of F_1, F_2 and F_3 hybrids manifest lowest radiosensitivity. (auth)

34762 beta-MERCAPTOETHANOL-INDUCED RECOVERY OF X-IRRADIATED YEAST CELLS. James, A. P.; Werner, M. M. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Genet. Cytol.; 11: 848-56(Dec 1969). (AECL-3447).

Prolongation of the interval between x irradiation and first post-irradiation cell division of diploid yeast cells by treatment with β-mercaptoethanol resulted in an increase in survival and a decrease in lethal sectoring among survivors. With haploids, a statistically significant increase in survival was not detected. A similar artificial prolongation of the interval between first and second postirradiation division of diploids resulted in a significant increase in the frequency of survivors that were free of lethal sectors, an indication that repair occurs in this interval and thus that some types of x-ray-induced lesions can persist through DNA replication. After treatment of x-irradiated cells with β-mercaptoethanol the relative frequencies of the different kinds of death (doublet formation, abortive colony formation, and lethal sectoring) were significantly altered, the frequency of recovery in each category being negatively correlated with the ex-

tent of residual cell division. It was concluded that the expressions of death reflect to some extent the number of lesions induced within a cell. (auth) (Canada)

34763 STUDIES ON RADIOSENSITIVITY OF HIGHER PLANTS. Donini, B. (CNEN, Rome). G. Bot. Ital.; 102: 556-7(1968). (In Italian). (RT/BIO-(69)18).

In a series of experiments carried out since 1960 at the gamma field of the Casaccia Nuclear Research Center (Rome), the effects of chronic or acute gamma radiation from ^{60}Co source on more than 100 herbaceous and woody plant species, were studied. The species were chronically irradiated (20 hours day) at different exposure rates during their life cycle or acutely at particular developmental stages. The following effects were examined: morphological: plant height reduction, habitus of growth, stem, leaf and flower abnormalities; cytological: pollen abortion, mitotic and meiotic aberrations; histological: mitotic inhibition of meristems, shoot apex necrosis; physiological: fresh and dry weight, seed production and germinability. The analysis of all these parameters allowed evaluation of the radiosensitivity of the species. A severe growth inhibition was observed in Pinus halepensis and Pinus pinca at the exposure rates of 8–10 R/d while the same effect was obtained at progressively higher exposures in Juniperus, Thuja, Vicia, Pisum, Triticum, Avena, Trifolium, Datura, Nicotiana, Papver, Penstemon, Campanula. A severe growth inhibition in the more radioresistant species as Cannabis, Linum, Dianthus, Capsella bursa-pastoris at the exposures of 700–1,000 R/d was observed. Among the investigated species a difference of 100 times in radiosensitivity was found. The following factors that might control the radiosensitivity were taken into consideration: chromosome number, nuclear volume, nuclear DNA content, degree of polyploid, length of mitotic cycle, number of the cells of the meristem and genotypic constitution of the species. According to literature, it has been found that species, having a large chromosome and nuclear volume, a higher nuclear DNA content, are more radiosensitive. Furthermore, the diploid species of the genus Avena, Bromus, Triticum that are more radiosensitive than tetraploid and exaploid seem to indicate the importance of the ploidy degree. Under chronic irradiation, the length of mitotic cycle and the number of the cells of the meristem showed influence on the radiosensitivity. The longer the mitotic cycle and the lower the number of the cells of the meristem, the higher is the radiosensitivity of the species. The importance of the genotypic constitution on the radiosensitivity was ascertained in Nicotiana species and in lines of Pisum. (auth)

34764 INFLUENCE OF RADIOTOXINS FROM IRRADIATED PLANTS UPON THE GROWTH OF NORMAL TISSUES AND MALIGNANT TUMORS. Kryukova, L. M.; Kuzin, A. M. (Inst. of Biophysics, Pushchino-on-Oka, USSR). Tr. Kaz. Nauch.-Issled. Inst. Onkol. Radiol.; 6: 133-5(1969). (In Russian).

Radiotoxins from irradiated plants increased cell death in Jensen sarcoma and Heren carcinoma of rats. The effect of radiotoxins on ascites tumors in rats was to cause a decrease in the volume and cell concentration. In some cases intraperitoneal injection of radiotoxins led to complete disappearance of tumors. (auth)

34765 EFFECT OF X-RAY IRRADIATION ON REGENERATION AND GEOTROPIC FUNCTION OF BARLEY ROOT CAPS. Cercek, Lea (Holt Radium Inst., Manchester, Eng.). Int. J. Radiat. Biol.; 17: 187-94(1970).

Root-cap regeneration and geotropic function after removal of the differentiated part of the cap were studied in barley roots. Geotropic response was regained when about 35 per cent of the root-cap length was regenerated. The geotropic response progressively increased with increasing length of the differentiated part of the root cap. Irradiation of the root-cap meristem inhibited the regeneration of the root cap. After irradiation in air, the geotropic response of the regenerated root cap decreased with increasing doses. Hypoxic (about 12 ppm of O_2 in a gas phase) conditions during irradiation with doses as high as 2400 rads completely protected the function of the partially regenerated root cap. Iodine tests on starch statoliths, and electron micrographs of root-cap cells regenerated from cap initials irradiated in the presence of oxygen, revealed a reduction in the number and size and changes in the chemical composition of starch statoliths in the amyloplasts; but there were no such effects in the absence of oxygen. It is suggested that the inhibition of the geotropic response of the root caps regenerated from cap initials irradiated in air is due to damage suffered by the genetic apparatus controlling the synthesis of the starch statoliths. (auth) (UK)

34766 INTERPRETATION OF THE γ RAY SURVIVAL CURVES OF CHLORELLA. Gilet, R. (CEA, Grenoble, France); Terrier, J. Bull. Inform. Sci. Tech. (Paris); No. 145, 67-72(Feb 1970). (In French).

A kinetic theory of the radiation effects on Chlorella is proposed. It is based on the experimental results obtained by the split dose method. The loss of reproductive capacity would take place in two steps: the first one where the repair is possible, the second one where there is no repair. The theoretical curves are superposed upon experimental ones. The curves obtained by the split dose method are in good agreement with the proposed scheme. (France)

34767 EFFECT OF SPLIT-DOSE UV IRRADIATION ON DIPLOID YEAST. Kiefer, J. (Justus-Liebig Univ., Giessen, Ger.). Photochem. Photobiol.; 11: 37-47(Jan 1970).

Recovery from sublethal damage by uv irradiation as measured by the split-dose technique was investigated in stationary phase populations of diploid yeast Saccharomyces cerevisiae. It has been found that only about 35 per cent of the irradiated population is able to undergo recovery before the first subsequent cell division. The qualitative pattern is not changed if maximum photoreactivation is allowed after the first dose. Measurements of the decay of photoreactability show that primary photo-products are still present up to six hours after irradiation. (auth) (UK)

34768 RECOVERY PHENOMENA IN YEAST. I. THE LETHALITY AND MITOTIC RECOMBINATION INDUCED BY γ-RAYS AND CHEMICALS IN UV-SUPERSENSITIVE MUTANT OF YEAST. Olteanu, V.; Kuznetsova, O. D.; Arman, I. P. Inst. of Atomic Energy, Moscow). Genetika; 6: No. 2, 123-9(Feb 1970). (In Russian).

The lethality and mitotic recombination induced by uv, γ rays, nitrous acid (NA), and nitrosoguanidine (NG) on uv-radiosensitive diploid yeast Saccharomyces cerevisiae were studied. The results were compared with those obtained for wild-type cells. It was found that the cross sensitivity of UVS_1-mutant to treatment by ionizing radiation and chemicals did not take place. On the basis of these facts, a possible localization of the damage to the dark recovery system, resulting from UVS_1-mutation, is discussed. The effectivities of γ rays, uv radiation, NA, and NG for induced mitotic recombination are compared. (auth)

34769 THE EFFECTS OF ACUTE ^{60}Co γ RADIATION ON THE DEVELOPMENT, GROWTH, AND BIOCHEMICAL PROCESS DYNAMICS IN SUNFLOWER. Kovacik, A.; Skalska, R.; Kryzanek, R. (Inst. of Genetics and Plant Breeding, Prague). Genet. Slechteni; 6: 11-24(Feb 1970). (In Czech).

At the beginning of development and growth, sunflower plants show an approximately equal response to irradiation as the plants from irradiated achenes with a higher content of water. An optimum dose for the application to the plants in the phase of the first pair of leaves to the 3rd to 4th right leaf is about 1 to 2 kr. The stimulation of the development and growth by means of low doses of acute ^{60}Co (0.5 and 1 kr) irradiation obtained in the X_1 generation in sunflower plants shows a close correlation with the biochemical changes of the stimulation of the formation of amino acids and saccharides. The stimulative, optimum and lethal doses for the achenes of sunflower with different water contents, and for sunflower plants during the first phases of development and growth are summarized. (auth)

Radiation Effects on Microorganisms

Refer also to abstracts 34077, 34094, 34099, 34103, 34110, 34121, 34173, 34238, 34241, 34242, 34247, 34249, 34260, 34278, 34281, 34292, 34403, 34574, 34826–34829, 34832, 34834, and 35365.

34770 EFFECTS OF GROWTH CONDITIONS ON SENSITIVITY OF ESCHERICHIA COLI TO INACTIVATION BY ULTRAVIOLET AND ^{32}P DECAY. Yan, Y. (Kyoto Univ.). Jap. J. Genet.; 44: 275-84(Dec 1969).

A comparative study was made of the kinetics of inactivation of Escherichia coli strain 15 $T^-A^-U^-$ by ultraviolet radiation and by the β decay of incorporated ^{32}P atoms among different physiological states. The bacteria in logarithmic phase in the glucose medium were more sensitive to uv radiation than those growing at lower rates in the succinate, aspartate, and proline media. Having grown under the absence of protein synthesis, the bacteria became strikingly resistant to uv radiation and had the same survivals irrespective of growth media. The uv radiosensitivity of 5-bromouracil (BU)-substituted bacteria also varied, reflecting the growth medium in which they incorporated BU into DNA. The sensitivity of the bacteria to the decay of ^{32}P atoms that had been uniformly incorporated was not substantially altered by the change in growth conditions. A considerable fraction of ^{32}P pulse-labeled cells in the succinate medium escaped from inactivation through the majority of those pulse-labeled in the glucose medium were susceptible. The relation between the sensitivity of the bacteria to uv and ^{32}P decay and the number of chromosomes per cell and the

DNA replication cycle, and also the character of the lethal damage induced by uv radiation and ^{32}P decay are discussed. (auth)

34771 COMPARISON OF THE EFFECTS OF ULTRAVIOLET LIGHT AND ETHYLMETHANESULPHONATE UPON THE FREQUENCY OF MITOTIC RECOMBINATION IN YEAST. Parry, James M. (Swansea Univ., Eng.). Mol. Gen. Genet.; 106: 66-72(31 Dec 1969).

Diploid cultures of the yeast Saccharomyces cerevisiae were treated with uv light and ethylmethanesulphonate and investigated for mitotic recombination and cell survival. Intergenic recombination was induced to the same frequency by both treatments at the same survival level whereas EMS induced more intragenic recombinants than uv treatment at the same survival. The mechanisms of induction of both recombinational events are discussed. (auth)

34772 INDUCTION OF PHAGE λ BY TRANSFERRED IRRADIATED coli DNA. Monk, Marilyn (Medical Research Council, Edinburgh). Mol. Gen. Genet.; 106: 14-24(31 Dec 1969).

Induction of prophage λ in a lysogenic recipient cell may be brought about by mating with ultraviolet irradiated donor cells carrying a transmissible plasmid such as colI (indirect induction). Doses of irradiation to the colI donor required to bring about indirect induction of lysogenic recipient cells reduce to an undetectable level the transfer of viable colI factors to non-lysogenic cells. It is shown by autoradiography that this irradiation does not significantly affect the frequency or amount of colI DNA transfer. Nalidixic acid prevents transfer of colI DNA and also prevents indirect induction. It is concluded that indirect induction results from the transfer of an uv-damaged colI factor. Transfer of the radiation-damaged colI factor to non-lysogenic cells leads to inhibition of division of these cells resulting in filament formation, but has little if any effect on cellular DNA replication. (auth)

34773 REGIONAL RADIOSENSITIVITY OF BACTERIAL SPORES. Lefebvre, Gerald M.; Preiss, John W. (Univ. of Delaware, Newark). Radiat. Res.; 42: 488-97(Jun 1970).

Ionizing radiation can induce bacterial spores to undergo changes associated with germination. By using low-energy electrons it was possible to separate two regions of the spore radiosensitive with respect to loss of optical density. These two regions coincide with two regions radiosensitive with respect to loss of viability. The region deep within the spore is particularly sensitive to loss of viability, while that region near the surface is particularly sensitive to loss of optical density. (auth)

34774 THE EFFECT OF GLUCOSE ON THE HOST-CELL REACTIVATION OF ULTRAVIOLET- AND GAMMA-IRRADIATED T1 PHAGE IN ESCHERICHIA COLI. Meyn, Raymond Everett Jr. Lawrence, Kan.; Univ. of Kansas (1969). 122p.

Thesis.

The effect of glucose on the host-cell reactivation (HCR) of T1 phage was investigated in order to determine whether cells grown in nutrient broth plus glucose have enhanced DNA repair. In addition, experiments designed to determine which genes affecting radiation sensitivity in Escherichia coli K-12 control HCR of γ-ray-induced damage (γ-HCR) were performed. Phage T1, irradiated with either ultraviolet light (uv) or γ rays, were preadsorbed onto cells grown in nutrient broth (NB) or nutrient broth plus glucose (GHB). A summary of the results is as follows. For a given dose, the survival of uv-irradiated phage preadsorbed onto hcr^- and uvr^- rec^+ strains grown in GNB was greater than that of phage preadsorbed onto cells grown in NB. Glucose-enhanced phage survival (GEPS) was not observed for uv-irradiated phage on strains whose genotype was hcr^+, uvr^+ rec^+, uvr^+ rec^-, or uvr^- rec^-. The presence or absence of the rec^- genotype in the host cells had no effect on survival of uv-irradiated phage. Gamma-irradiated phage were relatively resistant when plated on uvr^+ or hcr^+ strains. These phage were relatively sensitive when plated on uvr^- or hcr^- strains and were most sensitive when plated on AB2480 (uvr^- rec^-). Strain B/r (hcr^+) did exhibit GEPS for γ-irradiated phage but uvr^+ K-12 strains did not. Strains which were hcr^- or uvr^- also exhibited GEPS. These results suggested that γ-HCR may represent the repair of γ-ray-induced damage in phage by the excision-repair system of cells. A model for the repair of radiation-induced damage in bacteria and phage was postulated that could explain the apparent lack of a correlation between the radiation sensitivities of the various strains and the sensitivities of irradiated phage on the strains. It was concluded that GEPS must represent the enhancement of repair or bypass of radiation-induced damage in phage in glucose-grown cells. (Diss. Abstr.)

34775 RADIOSENSITIZATION OF ESCHERICHIA COLI B/r BY SHOWDOMYCIN. Titani, Yoiti; Katsube, Yutaka (Shionogi and Co., Ltd., Osaka). Biochim. Biophys. Acta; 192: 367-9 (18 Nov 1969).

Showdomycin, isolated from Streptomyces showdoensis, is a white crystalline water-soluble antibiotic, found recently to be 2-(β-D-ribofuranosyl)maleimide. Definite antitumor activity against Ehrlich mouse ascite tumors in vivo and cultured HeLa cells has been reported. The radiosensitization effect of this compound on Escherichia coli B/r was studied in comparison with the other thiol-binding reagents, i.e., p-chloromercuribenzoate, p-chloromercuriphenyl sulfonate, and N-ethylmaleimide, using γ rays under aerobic conditions. To test the effect of showdomycin, cells were incubated with 10 ml of showdomycin at an appropirate concentration in buffer 30 min at room temperature and then irradiated. Fractions of 40-kR-irradiated E. coli B/r that survived at various concentrations of showdomycin were determined, and the dose-survival curve obtained in the presence or absence of 1×10^{-3} M of showdomycin. A radiosensitizing effect appeared at 1×10^{-4} M but did not increase until 1×10^{-2} M. Although the dose-survival curve was very similar to that observed with N-ethylmaelimide, the dose-modifying factor of 1.6 that is calculated is considerably larger than that obtained with 1×10^{-3} M n-ethylmaleimide under aerated conditions. On the other hand, toxicity of this compound is lower than that of the other thiol-binding reagents at the concentration where the radiosensitization was observed. Related findings indicate that this antibiotic has low reactivity with intact cells, and therefore has low toxicity to the cell. (BBB)

34776 SYNERGISTIC KILLING OF BACTERIA BY X-RAYS, ULTRAVIOLET LIGHT, AND ^{32}P DECAY. Bhaumik, Gayaram; Bhattacharjee, S. B. (Saha Inst. of Nuclear Physics, Calcutta). Radiat. Res.; 42: 519-27(Jun 1970).

Interaction of x-ray, ultraviolet (uv) light, and ^{32}P decay in killing cells was studied for the strain E. coli 15 T−A−U−M−Pr−Tr−Sm_r. It was found that previous ^{32}P decay was capable of sensitizing the cells to later x- or uv-irradiation. It also resulted in the removal of the shoulders from the corresponding survival curves. Also, previous uv-irradiation sensitized the cells to subsequent killing by ^{32}P decay. This increase in sensitivity of the cells grown at 1.5 mCi/mg of P was maximum at the pre-uv dose of 1600 ergs/mm^2. However, on x-ray exposures the sensitivity of the cells to ^{32}P decay was not affected up to 24 krads. But when the cells were previously x-irradiated to 36 krads, an observable increase in the sensitivity of the cells to killing by incorporated ^{32}P decay was noticed. (auth)

34777 THE INFLUENCE OF OXYGEN AND SULPHHYDRYL COMPOUNDS ON THE PRODUCTION OF BREAKS IN BACTERIOPHAGE DNA BY GAMMA-RAYS. van der Schans, G. P. (National Defence Research Organization TNO, Rijswijk, Netherlands); Blok, Joh. Int. J. Radiat. Biol.; 17: 25-38(1970).

After irradiation of T4 or T7 bacteriophage with γ-rays, the DNA was isolated and analyzed for double- and single-strand breaks by sedimentation in a sucrose gradient. In the absence of oxygen, the number of double-strand breaks per krad and per molecular weight of 10^9 daltons is 0.04. In the presence of oxygen it is 0.08. The yield of single-strand breaks is 10 to 20 times higher than that of double-strand breaks. It is shown that in bacteriophage the increase of the production of DNA breaks by oxygen does not manifest itself as an increased sensitivity of the bacteriophage as a whole, because the presence of oxygen prevents other types of damage, presumably in the protein coat. If sulphhydryl compounds are present the yield of breaks is not much affected, but the amount of other damage is considerably reduced. A normal oxygen effect is then observed. (auth) (UK)

34778 INVESTIGATIONS ON ONCOGENIC TRANSFORMATION, INDUCTION OF DNA-SYNTHESIS, AND T-ANTIGEN FORMATION BY UV-IRRADIATED SIMIAN VIRUS (SV-) 40. Seemayer, N.; Seemayer, G.; Haas, R. (Univ., Freiburg i. B.). Z. Med. Mikrobiol. Immunol.; 155: 123-32(1969). (In German).

Ultraviolet irradiation of SV 40 was shown to reduce considerably the infectivity, the ability to induce T-antigen, and the induction of DNA synthesis. Oncogenicity, however, was reduced only slightly in vitro and in vivo. The ability of SV 40 to replicate, to form T-antigen, and to induce DNA synthesis do not seem to be necessary conditions for oncogenic potency in vitro or in vivo. Several interpretations, as well as the possible implication for vaccine production, are discussed. (auth)

34779 THE OVER-ALL APPROACH AND GOAL OF THE CHICAGO SANITARY DISTRICT IN THE USE OF RADIATION. Stein, Jerome E.; Bacon, Vinton W. Amer. J. Public Health; 59: 2257-63(Dec 1969).

The Metropolitan Sanitary District of Greater Chicago has, as do most similar agencies, the problem of solids disposal. The various methods and their uses in the disposal of sludge by the

Metropolitan Sanitary District of Greater Chicago are discussed. The utilization of gamma radiation, as it pertains to sludge conditioning, is also presented. It is concluded that gamma radiation can best be applied to the thickening and disinfection of activated sludge. The irradiated sludge is then digested and ultimately used in land reclamation. (auth)

34780 HOST CONVERSION BY PROPHAGE LAMBDA IN A RECOMBINATION-DEFICIENT MUTANT OF ESCHERICHIA COLI. Erskine, J. M. (New Zealand Dairy Research Inst., Palmerston North). J. Gen. Virol.; 5: 161-9(Sep 1969).

A description is given of a case of host conversion. After lysogenization with wild-type λ phage a rec⁻ mutant of Escherichia coli K12 displayed rec⁺ properties in respect of conjugational recombinant formation and response to uv irradiation. The bacteria show normal uv sensitivity and are proficient in the system that leads to liberation of phage. Superinfection of the inducible form with phage 21b2 led either to loss of the prophage or to the infrequent production of a form which was still lysogenic but no longer inducible. In both cases the bacteria regained their rec⁻ conditions as a result of the curing treatment. The phage released from AB2463(λ) (ind) was normal λ. It is concluded that the rec⁺ phenotype of AB2463(λ) (ind) derives from the presence of the prophage and represents a case of host conversion. It is proposed that AB2463(λ) (ind) is doubly lysogenic for λ and that partial curing yields the rec⁻ single lysogen AB2463(λ). (BBB)

34781 SURVIVAL OF MICROCOCCUS RADIODURANS IRRADIATED AT HIGH LET AND THE EFFECT OF ACRIDINE ORANGE. Dewey, D. L. (Mount Vernon Hospital, Northwood, Eng.). Int. J. Radiat. Biol.; 16: 583-92(1969).

The radiation survival curve of Micrococcus radiodurans consists of a long flat shoulder, followed by an exponential part. When acridine orange is added to the growth medium after irradiation, the shoulder is reduced without changing the final slope. A method is described whereby a measure of repair is obtained from the length of shoulder, and a measure of unrepaired damage from the final slope. With changing LET, these two features of the curve differ. The final slope has a definite optimum LET for maximum sensitivity at a value very near to that for yeast and higher organisms. The length of the shoulder steadily increases as LET increases, suggesting that the target for inactivating the repair mechanism is different from the lethal target. (auth) (UK)

34782 INFLUENCE OF SEMI-DEHYDRATION ON THE RESPONSE OF STREPTOCOCCUS LIQUEFACIENS TO ULTRAVIOLET LIGHT. Webb, S. J.; Malwinska, Kristina (Univ. of Saskatchewan, Saskatoon). Photochem. Photobiol.; 11: 109-19 (Feb 1970).

The effect of relative humidity on the survival and sensitivity to radiations of Streptococcus liquefaciens was studied. The microorganism was little affected by dehydration in aerosols and its sensitivity to the lethal action of 2537 Å light was unaffected by changes in the relative humidity at which the cells were held during irradiation. The cells were more stable to the lethal action of 3200 to 4000 Å, however, when they were held at 70% relative humidity than at 50 or 30% relative humidity. Mutant cells unable to liquify gelatine were induced by semi-dehydration at 50% relative humidity and their numbers were increased by concomitant irradiation with 3200 to 4000 Å light. This type of mutant was not observed when the cells were irradiated with 2537 Å light. Mutant cells that had a different response from that of the parent cell to the presence of oxygen in their growth medium were produced by both wavebands of light, but only when the cells were held at 50% relative humidity. It is proposed that semi-dehydration stresses the cell membrane and damages those parts of the bacterial DNA associated with the membrane. Concomitant irradiation is suggested to enhance this particular effect. (auth) (UK)

34783 THE INACTIVATION OF THE NUCLEAR POLYHEDROSIS VIRUS OF TRICHOPLUSIA NI BY GAMMA AND ULTRAVIOLET RADIATION. Jaques, R. P. (Canada Dept. of Agriculture, Kentville, Nova Scotia). Can. J. Microbiol.; 14: 1161-3(Oct 1968).

The activity of the nuclear polyhedrosis virus of Trichoplusia ni was reduced by 90% when exposed as an aqueous suspension of polyhedra to a dose of 3×10^5 rads of gamma radiation. A dose in excess of 1×10^7 rads completely inactivated the virus in suspensions. The virus was more readily inactivated when exposed as dry deposits of polyhedra than as aqueous suspensions. Bacterial contaminants in the viral suspensions were more sensitive to gamma radiation than was the virus but the virus was the more sensitive to ultraviolet light. (auth) (Canada)

34784 REPAIR MECHANISM IN IRRADIATED CELLS. Krsmanovic-Simic, D.; Errera, M. (Free Univ., Brussels). Arh. Hig. Rada Toksikol.; 20: 143-54(1969).

Bacterial mutations that lead to enhanced sensitivity to uv radiation and x rays were studied. Radiosensitivity is due to a loss of capacity to repair damaged DNA. A genetic map of the mutations involved is shown for the chromosome of Escherichia coli. The best known DNA repair mechanisms are by excision (excision of pyrimidine dimers controlled by non-linked uvr genes) and recombination (elimination of damage by genetic recombination between undamaged regions of DNA). An understanding of the lethal and mutagenic effects of radiation is based on identification and quantitative estimation of various lesions in DNA. UV radiation causes formation of many types of photochemically altered products, but formation of pyrimidine dimers appears to be the most important damage causing biological inactivation. A study of biochemical defects of uv-sensitive mutants has led to a partial understanding of repair mechanisms. They generally consist of removal by cellular enzyme systems of pyrimidine dimers formed under the action of uv radiation. Lesions induced by x rays are more diverse and not as well known. The mechanism of their repair is not as well understood as in the case of damage due to uv radiation. (JPRS)

34785 THE ACTION OF MUTAGENS ON PHAGE MS2 AND ITS INFECTIVE RNA. II. A COMPARATIVE STUDY OF THE KINETICS OF LETHAL AND MUTAGENIC EFFECTS OF NITROUS ACID AND UV-IRRADIATION ON EXTRACELLULAR PHAGE MS2 AND ITS INFECTIVE RNA. Kriviskii, A. S.; Sherban, T. P. (Inst. of Molecular Biology, Moscow). Genetika; 6: No. 1, 129-43(Jan 1970). (In Russian).

A comparative study of the kinetics of lethal and mutagenic effects of nitrous acid and uv irradiation on extracellular phage MS2 and its infective RNA was carried out. The inactivating effect of nitrous acid both on phage MS2 and its RNA followed exponential law, the rate of RNA inactivation being 1.5 to 2 times that of the whole phage. Treatment of RNA with nitrous acid resulted in the formation of plaque-type mutants that did not differ phenotypically from spontaneous mutants and those induced by nitrous acid in the population of the intact phage. The relative number of induced mutants increased linearly with duration of mutagen treatment up to the doses corresponding to 2 to 3 lethal hits, thereupon the plateau and a sharp drop of the curve occurred. Linear dependence of the number of induced mutants after mutagen treatment of the whole phage was observed up to doses corresponding to 10 lethal hits. The effectivity of the induction of mutations with nitrous acid was similar for RNA and the whole phage on the linear portion of the mutation curve, i.e., deamination of the three nitrous bases was realized to the same extent both in isolated RNA and the whole phage. Inactivation of the MS2 RNA by uv irradiation followed exponential law and proceeded at the same rate as that of the whole phage. Ultraviolet irradiation induced only lethal but not mutagenic damage in the infective RNA. (auth)

34786 ROLES OF WATER IN THE CELLULAR EFFECTS OF IONIZING RADIATIONS. Powers, E. L.; Tallentire, A. (Univ. of Texas, Austin). pp 1-67 of Actions Chimiques et Biologiques des Radiations. /Haissinsky, M. (ed.). Paris; Masson et Cie, Editeurs (1968).

The question of water action in cellular radiation damage is reviewed; primarily, research that presented basic information directly relevant to the problem of water and biological sensitivity to radiation were included. The bacterial spore as the biological model was used to discuss the following: the O_2-independent part of the radiation response in the spore, the long-lived free radical component of damage, and the effect of H_2O on the immediate O_2 effect. In vegetative bacterial cells the three components of radiation damage were discussed and compared with those of the spore system. Radiation damage and the effect of water in plant embryos and eggs of Artemis were also discussed. The role water plays (suppressive or protective) in the action of uv radiation in several kinds of cells is included in the review. (144 References) (C.O.)

34787 REPAIR BY CELLS OF DAMAGE CAUSED BY RADIATIONS OR BY RADIOMIMETIC CHEMICALS. Read, John (Wakari Public Hospital, Dunedin, N. Z.). pp 145-96 of Actions Chimiques et Biologiques des Radiations. /Haissinsky, M. (ed.). Paris; Masson et Cie, Editeurs (1968).

Repair processes that are natural functions of cells that can be considered to have evolved to enable them to cope with cosmic and earth radiations, sunlight, and chemicals with comparable actions are discussed. The discussion is restricted to experiments on bacteria and unicellular organisms; some work on the induction of mutations in animals is included because of its link with the earlier material and with medical problems. (C.O.)

34788 EFFECT OF γ-IRRADIATION ON SPORES OF SOME SPECIES OF THE CLOSTRIDIUM GENUS. Plecas, M.; Bittner,

J.; Voinescu, Viorica (Inst. of Hygiene, Bucharest). Acta Biol. Med. Ger.; 23: 921-3(1969).

A few hundred thousand spores of several species of Clostridium were subjected to γ radiation in the following doses: 500,000; 1,000,000; and 1,500,000 R. The number of surviving spores was established by inoculating on agar before and after irradiation. Results showed that C. histolyticum was most resistant, followed by C. septicum, C. sporogenes, and C. tetani. C. perfringens was least resistant; the spores of this species were completely inactivated by a dose of 1,500,000 R. Since the degree of resistance of Clostridium spores was similar for chemicals, heat, and radiation, it is suggested that the determining genetic factor is the same for all. (tr-auth)

34789 ULTRAVIOLET DEVITALIZATION OF EIGHT SELECTED ENTERIC VIRUSES IN ESTUARINE WATER. Hill, William F. Jr.; Hamblet, Frederick E.; Benton, William H.; Akin, Elmer W. (Public Health Service, Dauphin Island, Ala.). Appl. Microbiol.; 19: 805-12(May 1970).

The effect of uv radiation on the devitalization of eight selected enteric viruses suspended in estuarine water was determined. The surviving fractions of each virus were calculated and then plotted against the uv exposure time for purposes of comparison. Analytical assessment of the survival data for each virus consisted of least squares regression analysis for determination of intercepts and slope functions. All data were examined for statistical significance. When the slope function of each virus was compared against the slope function of poliovirus type 1, the analytical findings indicated that poliovirus types 2 and 3, echovirus types 1 and 11, and coxsackievirus A-9 exhibited similar devitalization characteristics in that no statistically significant difference was found ($P > 0.05$). Conversely, the devitalization characteristics of coxsackievirus B-1 and reovirus type 1 were dissimilar from those of poliovirus type 1 in that a statistically significant difference was found between the slope functions ($P < 0.05$). This observed difference in devitalization of coxsackievirus B-1 and reovirus type 1 was attributed primarily to the frequency distribution of single and aggregate virions, the geometric configuration, the size of the aggregates, and the severity of aggregation. The devitalization curve of coxsackievirus B-1 was characteristic of a retardant die-away curve. The devitalization curve of reovirus type 1 was characteristic of a multihittype curve. The calculated devitalization half-life values for poliovirus types 1, 2, and 3; echovirus types 1 and 11; coxsackievirus types A-9 and B-1; and reovirus type 1 were 2.8, 3.1, 2.7, 2.8, 3.2, 3.1, 4.0, 4.0 sec, respectively. These basic data should facilitate an operative extrapolation of the findings to the applied situation. It was concluded that uv can be highly effective and provide a reliable safety factor in treating estuarine water. (auth)

34790 ULTRAVIOLET REPAIR CAPABILITIES OF AGROBACTERIUM TUMEFACIENS. Yajko, D. M.; Tershak, D. R. (Pennsylvania State Univ., University Park). Can. J. Microbiol.; 14: 927-31(Sep 1968).

Agrobacterium tumefaciens was shown to possess many of the ultraviolet repair mechanisms that are known to occur in Escherichia coli. Positive results were obtained for photoreactivation, dark reactivation, and host-cell reactivation. Host-cell reactivation of A. tumefaciens was demonstrated by employing a lytic phage. In the presence of caffeine, the survival of virus after ultraviolet treatment was much lower than in the controls. Attempts to demonstrate ultraviolet reactivation of the virus were negative. Thus, it was hypothesized that host-cell reactivation and ultraviolet reactivation are accomplished, at least in part, by different enzyme systems. (auth) (Canada)

34791 PHOTOREACTIVIBILITY AND UV-SENSITIVITY OF ESCHERICHIA COLI PRELIMINARILY IRRADIATED WITH α-RAYS. Zavolnaya, E. S. (Inst. of Cytology, Leningrad). Tsitologiya; 12: 64-76(Jan 1970). (In Russian).

The alteration of photoreactivation due to a preliminary α irradiation was investigated with three strains of E. coli: B/r WP2, B and B_{s-1}. The photoreactivation of all the three strains was found to decrease when the bacterial cells had been preliminarily irradiated with heavy doses of α particles (decrease of the survival rate by a magnitude of 4 to 5). The uv-radiosensitivity of E. coli B/rWP2 was found to increase as a result of the preliminary α irradiation in all the investigated post-irradiation conditions; the same was true for the strain B cultivated on nutrient fish-peptone agar medium at 45° or on the minimal medium (M-9) at 37°. The influence of α rays was practically nothing when the cells of strain B were cultivated on the fish-peptone nutrient agar at 19° and 37° and for the strains B_{s-1} in all the investigated conditions. The decrease of photoreactivation of E. coli did not correlate with the increase of bacterial uv-radiosensitivity that may be observed after a preliminary α irradiation. (auth)

34792 REPAIR OF ULTRAVIOLET LIGHT DAMAGE BY A FACULTATIVE AUTOTROPH: HYDROGENOMONAS FACILIS. Pootjes, C. F. (Pennsylvania State Univ., University Park). Can. J. Microbiol.; 14: 1205-10(Nov 1968).

Hydrogenomonas facilis ATCC 15376 was shown to possess a photoreactivation system that was able to repair ultraviolet radiation damage under both heterotrophic and autotrophic conditions. Acriflavin enhanced the lethal effect of ultraviolet radiation on H. facilis. Five strains of ultraviolet-irradiated bacteriophage specific for H. facilis were photoreactivated in infected bacteria. One strain, SH6, was markedly more resistant to ultraviolet inactivation. Visible light inhibited the synthesis of bacteriophage by H. facilis except for strain SH6. Incubation of SH6-infected bacteria in the light increased the titer more than 10-fold. (auth) (Canada)

34793 IN-VITRO EXPERIMENTS ON THE RADIOSENSITIVITY OF FOOD-AND-MOUTH DISEASE VIRUS AND OTHER ANIMAL VIRUSES TO THE DIRECT EFFECT OF X-IRRADIATION. Johnson, C. D. (Research Inst., Pirbright, Eng.). pp 65-9 of Elimination of Harmful Organisms from Food and Feed by Irradiation. Vienna; International Atomic Energy Agency (1968).

From Panel on Elimination of Harmful Organisms from Food and Feed by Irradiation, Zeist, Netherlands. See STI/PUB-200; CONF-670671.

Various in vitro techniques were used to observe the direct x-ray inactivation of foot-and-mouth disease virus, vesicular stomatitis virus and the virus of Teschen disease. All these methods were intended to eliminate the indirect effects of the irradiation, and for each virus an upper limit to the radioresistance was observed, that was assumed to correspond to inactivation by the direct effect. Further confirmation of the absence of indirect effects was obtained by observing the dose-rate and the concentration-independent survival curves, and by direct observation of the inactivated virus in the electron microscope. Virus suffering only direct inactivation retained its morphological integrity at a much higher radiation dose level (relative to loss of infectivity) than virus that was exposed to some residual indirect effects. These results are of value since the radioresistances observed represent the upper limits that may have to be taken into account in, for example, the elimination of foot-and-mouth disease virus from frozen meat. (auth)

34794 RESISTANCE OF SPORES OF CLOSTRIDIUM WELCHII. Roberts, T. A. (Meat Research Inst., Cambridge, Eng.). pp 95-100 of Elimination of Harmful Organisms from Food and Feed by Irradiation. Vienna; International Atomic Energy Agency (1968).

From Panel on Elimination of Harmful Organisms from Food and Feed by Irradiation, Zeist, Netherlands. See STI/PUB-200; CONF-670671.

Spores of classical and food-poisoning strains of Clostridium welchii were examined for their resistance to heat and γ radiation. Spores of classical strains were more sensitive to heat ($D_{90°C}$ 3 to 5 min) than spores of food-poisoning strains ($D_{90°C}$ 15 to 145 min). z-values of the former (11 to 14°F) were lower than those of the latter (16 to 29°F). Spores of food-poisoning strains were more resistant to γ radiation (D = 0.26 to 0.34 Mrad) than spores of classical strains (D = 0.12 to 0.21 Mrad). Radiation activation of viable count was not evident although heat activation of spores of food-poisoning strains was commonly observed. (auth)

34795 A COMPARATIVE STUDY OF INACTIVATION BY UV RADIATION OF NEO-ANTIGENS AND INFECTIOUS POWER OF ADENOVIRUSES 7 AND 12. Suarez, Horacio G. (Institut de Recherches Scientifiques sur le Cancer, Villejuif, France). Ann. Inst. Pasteur, 118: 220-3(Feb 1970). (In French).

A comparative study of the effect of uv irradiation on adenoviruses 7 and 12 showed that the multiplication of both adenoviruses was equally decreased by uv radiation and the capacity to induce the formation of neo-antigens in the infected cells was approximately four times more resistant to uv, for both viruses, than that of replication. (France)

34796 INVESTIGATION OF REGULARITIES OF BAC. MESENTERICUS VARIABILITY INDUCED BY A COMBINED ACTION OF DIFFERENT NATURE MUTAGENS. Pasichnik, A. M.; Luginina, T. M. Mikrobiol. Zh.; 30: 443-50(Sep-Oct 1968). (In Ukrainian).

As a result of studying the regularities of the Bacillus mesentericus strain "IIb-8" variability induced by the combined action of ethylenimine and uv rays or fast neutrons, the optimum conditions for accumulating the greatest amount of variants with a higher gelatinase activity are found. The strains exceeding the proteolytic activity of the initial strain "IIb-8" are selected by

means of step treatment with mutagens at multiple selection. One of them, 7099, is introduced into production for manufacturing enzyme preparation that is used in the process of regenerating triacetate films. (auth)

34797 THE EFFECT OF COPPER ON THE RADIOSENSITIVITY OF BACTERIA. Kirschner, Ilana (Soreq Nuclear Research Center, Yavne, Israel); Citri, Nathan; Levitzki, Alexander; Anbar, Michael. Int. J. Radiat. Biol.; 17: 81-5 (1970).

The specific radiosensitization of Bacillus cereus strains by Cu^{2+} is described. The bound copper enhances the radiosensitivity when OH radicals are the sole radiolytic products. It is suggested that Cu(III) species formed by OH oxidation of ligated Cu(II) are responsible for specific destruction of the copper binding sites. (auth) (UK)

34798 LEAF STRUCTURE AND CALLOSE FORMATION AS DETERMINANTS OF TMV MOVEMENT IN BEAN LEAVES AS REVEALED BY UV IRRADIATION STUDIES. Wu, J. H.; Dimitman, J. E. (California State Polytechnic Coll., Pomona). Virology; 40: 820-7(Apr 1970).

Pinto bean primary leaves infected with TMV-Ul produce small lesions. However, when leaves were irradiated with ultraviolet light (uv) 24 hours after inoculation, larger lesions developed in 1 to 2 days and subsequently enlarged when the leaves were kept dark (21-28°). The mechanism of increasing lesion size by uv irradiation was investigated to clarify its effect on virus spread from cell to cell and the nature of resistance of the untreated leaf cells to viral movement. Unirradiated control leaves formed small necrotic lesions involving mostly the upper epidermis and palisade tissue and only a small proportion of spongy tissue. One to two days after the upper side of the leaf was irradiated, necrosis involved a larger area of the upper epidermis and palisade layers and subsequently slowly involved spongy tissue. However, when the lower side of the leaf was irradiated, lesions in cross section resembled an inverted funnel shape necrosis involving mainly the lower epidermis and spongy parenchyma. The results may be interpreted as a weakening of the cellular resistance mechanism in uv-irradiated and darkened leaves. Callose deposition induced by necrosis was correlated with the rate of movement of TMV from infected to noninfected cells. Callose deposition was prevented by uv irradiation and darkening. The shape of the necrotic lesions seems to be correlated with the facility of spread of TMV into different tissues. When virus moved vertically from the inoculated upper epidermis to the lower epidermis through palisade and spongy tissue, uv irradiation of the lower side was not sufficiently strong to prevent callose deposition on the upper epidermal cells. Lateral movement of virus was mainly through the lower spongy layer and lower epidermis, producing a lesion shaped like an inverted funnel. In nonirradiated lesions, palisade parenchyma became necrotic only in cells directly under the necrotic upper epidermal cells, which were surrounded by a callose band. Apparently, there was no lateral movement of TMV in palisade parenchyma even though there was no conspicuous callose deposition on the walls of surrounding palisade parenchyma adjacent. This may be attributed to the paucity of lateral contact among palisade parenchyma cells. There was heavy deposition of callose in the spongy parenchyma adjacent to necrotic palisade or spongy cells, accounting for the usual lack of spread of necrosis into the lower spongy layer. When the upper side of the leaves was irradiated, no callose band was formed, and necrosis occurred in the upper epidermis and palisade cells. Lesions enlarged with time, but spongy cells were less involved. The uv doses used apparently did not reach the spongy tissue with sufficient intensity to prevent callose deposition there. (auth)

34799 DISTINCTIVE SULPHYDRYL RESPONSES IN X-IRRADIATED AND IN HEAT-TREATED MICROCOCCUS RADIODURANS. Freedman, M. L.; Freedman, P. L.; Bruce, A. K. (State Univ. of New York, Buffalo). Nature (London); 224: 183-4(11 Oct 1969).

It is found that in M. radiodurans the change in p-hydroximercuribenzoate (HMB) binding after x irradiation and heat exposure is similar, and that this response differs from the responses of more radiosensitive organisms such as E. coli B/r and Sarcina lutea. It was also found that M. radiodurans binds more HMB than expected from its larger mass. Shake cultures of the three organisms were grown to early stationary phase, and binding of HMB after x irradiation or after heat treatment was effected in phosphate buffer. Bound Hg was determined by neutron activation analysis, and data are presented for the relationship between mass and HMB binding in the three bacterial strains. It was found that M. radiodurans bound from three to 18 times more HMB on a per cell basis than the more radiosensitive strains. When cell suspensions were x irradiated while aerated in phosphate buffer the post-irradiation patterns of binding changed, and the response was consistent with the exhaustion of SH groups (HMB binding sites) through H donation or radical-mediated oxidation. Irradiation of the E. coli and S. lutea appeared to generate SH groups, probably because of protein uncoiling and disulphide reduction. Data are also given showing the radiomimetic action of exposing the three types of organism to heat treatment in phosphate buffer. No appreciable changes in binding were observed at lower temperatures; at higher temperatures cell lysis often occurred. These responses are also compatible with endogenous SH oxidation in M. radiodurans and with protein denaturation leading to masked SH group oxidation in the other two organisms. The observed early responses may well reflect changes in cellular sulphydryl quality and quantity pertinent to survival. M. radiodurans appear to have an abundant, expendable and probably protective SH component, the amount of which decreases with x irradiation and heat treatment, while the other two organisms generate HMB-binding SH groups at the expense of other vital molecules. (UK)

34800 MECHANISM OF THE SENSITIZATION OF BACTERIAL TRANSFORMING DNA TO ULTRAVIOLET LIGHT BY THE INCORPORATION OF 5-BROMOURACIL. Hutchinson, Franklin; Hales, Harriet B. (Yale Univ., New Haven). J. Mol. Biol.; 50: 59-69 (28 May 1970).

The introduction of 5-bromouracil into Bacillus subtilis DNA allows uv radiation of wavelength 254 nm to produce single-strand breaks in fully substituted DNA at the rate of about 0.007 break/10^8 daltons/erg/mm^2. This rate is at least 500-fold greater than the rate for induction of breaks in DNA containing no bromouracil. Breaks are not produced in the strand containing thymine in hybrid DNA. It was shown that the loss of transforming activity by uv irradiation of B. subtilis DNA with all thymine replaced by bromouracil is quantitatively accounted for by the single-strand breaks, with negligible contribution from other damage to the bases. When thymine is fully replaced by bromouracil, the shape of the survival curve for transforming activity changes from the usual concave curve to an exponential one. The loss of transforming activity of hybrid DNA is greater than that which would be calculated under the assumption that the individual strands lose activity in the same way as the normal unsubstituted DNA and the fully substituted DNA. (auth)

34801 RELEASE OF NUCLEAR MATERIAL FROM X-IRRADIATED BACTERIA. Bhaumik, G.; Bhattachartee, S. B. (Saha Inst. of Nuclear Physics, Calcutta). Int. J. Radiat. Biol.; 17: 101-2(1970).

The results indicated that Escherichia coli B_{s-1} cells exposed to 4800 rads of x rays, released some nuclear materials of nucleotide nature which satisfied the requirements of a test organism for thymine and uracil. The released materials effects on the growth were different from those of normally added thymine. They induced an enormous number of "snakes" (filaments greater than two or three cell lengths). On uv irradiation, E. coli B_{s-1} did not show any release of nucleotide material, but uv irradiation before or after x ray exposure had no influence on the release from x-irradiated bacteria. (UK)

Radiosterilization and Radiopreservation

Refer also to abstracts 34118, 34152, 34166, 34167, 34606, 34759, 34789, and 34793.

34802 (STI/PUB-184) CONTROL OF LIVESTOCK INSECT PESTS BY THE STERILE-MALE TECHNIQUE. Panel Proceedings Series. Proceedings of a Panel Held in Vienna, 23-27 January 1967. (International Atomic Energy Agency, Vienna (Austria)). Jul 1968. 108p. (In French and English). (CONF-670125). IAEA $3.00.

Separate abstracts were prepared for six papers presented at the conference. An additional twelve papers are included on various aspects of insect control. (H.L.W.)

For abstracts of individual papers see: 34806-34811.

34803 (STI/PUB-200) ELIMINATION OF HARMFUL ORGANISMS FROM FOOD AND FEED BY IRRADIATION. Panel Proceedings Series. Report of a Panel Held in Zeist, Netherlands, 12-16 June 1967. (International Atomic Energy Agency, Vienna (Austria)). Jul 1968. 123p. (CONF-670671). IAEA $3.50.

Proceedings are presented of a panel organized by the Joint FAO/IAEA Division of Atomic Energy in Food and Agriculture, held at Zeist, The Netherlands, from June 12 to 16, 1967. The meeting was attended by 16 experts from 9 countries and one

international organization. Separate abstracts were prepared for 10 of the 12 papers presented. The topics include the elimination of Salmonella, the inactivation of viruses, the devitalization of parasites and the elimination of Clostridia by irradiation in different food and feed products. One paper was published elsewhere and the other dealt with tests for contamination in mixed-feed ingredients. (F.M.M.)

For abstracts of individual papers see: 34606, 34793, 34794, and 34826–34832.

34804 (TID–25288(Vol.3)) CHRONIC ANIMAL FEEDING STUDIES ON RADIATION-PASTEURIZED CLAMS. CHICKEN FEEDING EXPERIMENTS. Final Report. Fegley, Harry C.; Edmonds, Russell S. (Affiliated Medical Enterprizes, Princeton, N. J.). 31 May 1969. Contract AT(30-1)-3573. 141p. Dep. CFSTI.

Female chickens receiving 2X irradiated clams weighed significantly less than those receiving either of the controls or 1X irradiated clams. There was no significant difference among diet groups with respect to food efficiency. The addition of clams to the diet resulted in a significant decrease in female femur lengths. Irradiation was associated with a shift toward normal, so that females receiving 2X irradiated clams had femur lengths which were not significantly different from those in the normal control group. Irradiation at the 2X level was associated with a significant decrease in fertility of eggs. The addition of clams to the diet significantly reduced hatchability and embryo viability and these effects were enhanced by irradiation at the 2X level. The percentage of chicks surviving for 30 days was significantly reduced when clams were added to the diet. A further decrease was associated with irradiation. Females receiving irradiated clams had significantly larger kidneys than either control group. In addition, those receiving 2X irradiated clams had significantly larger kidneys than those receiving 1X irradiated clams. A decrease in male gonad weights was associated with the addition of clams to the diet. This effect was accentuated by irradiation. The 2X group had significantly smaller gonads than all other diet groups. The 1X group had significantly smaller gonads than the negative control group, but significantly larger gonads than either the clam control group or the 2X group. (auth)

34805 (TID–25312) STUDY OF IRRADIATED-PASTEURIZED FISHERY PRODUCTS. Annual Report, October 1, 1967–September 30, 1968. Ronsivalli, L. J.; King, F. J.; Ampola, V. G.; Holston, J. A. (Bureau of Commercial Fisheries, Gloucester, Mass. Technological Lab.). Apr 1970. Contract AT(49-11)-1889. 154p. Dep. CFSTI.

Data are reviewed from an eight-year study that demonstrated the feasibility of using ionizing radiation for the processing of iced seafoods to extend refrigerated storage life. Studies were made on haddock, pollock, ocean perch, cod, mackerel fillets, clams, lobster, crab, scallops, and shrimp. Radiopasteurization was found to be practical for cod and haddock fillets iced for as long as seven to ten days prior to irradiation. The preserving effect of radiation was attributed to reduction in the number of bacteria. Irradiation at 250 kilorads caused a reduction of about 99% in the number of bacteria. Flexible plastic materials were found to be suitable for packaging fish prior to radiation processing. Data on the storage life of radiation processed seafoods stored at 40°F are included. Results are also included from studies on the effects of γ radiation on the chemical composition of stored cod and haddock fillets. The greatest effect on the development of carbonyl compounds and changes in the free amino acid content and fatty acid composition was observed at doses ranging from 0.2 to 2.8 mrad with the effect proportional to the radiation dose. (84 references) (C.H.)

34806 POSSIBILITIES FOR USING THE STERILE-MALE TECHNIQUE IN TORSALO, DERMATOBIA HOMINIS, AND OTHER LIVESTOCK PESTS IN THE OIRSA AREA. Arce, A. A. (Organismo Internacional Regional de Sanidad Agropecuaria, San Salvador). pp 1-3 of Control of Livestock Insect Pests by the Sterile-Male Technique. Vienna; International Atomic Energy Agency (1968).

From Panel on the Control of Livestock Insect Pests by the Sterile-Male Technique, Vienna, Austria. See STI/PUB–184; CONF–670125.

Ecological and other biological studies were investigated for torsalo with a view to initiating a program of control by the sterile-male technique. Basic radiobiological information is available; however, artificial rearing continues to be unsuccessful. (auth)

34807 EFFECT OF GAMMA RADIATION ON THE FERTILITY OF TORSALO, DERMATOBIA HOMINIS (DIPTERA: CUTEREBRIDAE). Banegas, A. D. (Organismo Internacional Regional de Sanidad Agropecuaria, Tegucigalpa, Honduras). pp 19-22 of Control of Livestock Insect Pests by the Sterile-Male Technique. Vienna; International Atomic Energy Agency (1968).

From Panel on the Control of Livestock Insect Pests by the Sterile-Male Technique, Vienna, Austria. See STI/PUB–184; CONF–670125.

Research on the possible application of the sterile-male technique for controlling the torsalo required observations on the effect of gamma radiation on its fertility. Torsalo pupae, 20, 25, and 30 days old, were exposed to gamma radiation from a ^{60}Co source. Three dosages, of 5000, 7500, and 10,000 R, were used. These exploratory investigations showed that the most satisfactory time for the treatment was 25 days, representing $\frac{5}{7}$ of the pupal development at 25°C. All dosages used drastically reduced the fertility of the flies, but the 7500 R dose, which completely inhibits the development of ova in the females and reduces the fecundity of the males to 0.8%, is the appropriate dose for practical purposes. The sperm of the treated males retained its motility. The appearance and behavior of the treated flies was apparently normal. (auth)

34808 STERILIZATION WITH GAMMA-RAYS AND FIELD INVESTIGATIONS INTO THE BREEDING OF GLOSSINA MORSITANS. Dean, G. J.; Phelps, R. J.; Williamson, B. (Agricultural Research Council, Salisbury, Rhodesia). pp 31-6 of Control of Livestock Insect Pests by the Sterile-Male Technique. Vienna; International Atomic Energy Agency (1968).

From Panel on the Control of Livestock Insect Pests by the Sterile-Male Technique, Vienna, Austria. See STI/PUB–184; CONF–670125.

Gamma radiation between 8,000 and 15,000 Rad of pupae of Glossina morsitans of unknown age collected in the field reduced reproduction in male flies emerging within a week of treatment when mated with untreated females by more than 95%. Male flies emerging from pupae during the second and third post-treatment weeks were completely sterilized with dosages of 9,000 and 4,000 Rad respectively. Female flies were completely sterilized by 1,000 Rad. The survival of irradiated pupae and subsequent adult flies was reduced both by increasing dosage and by decreasing pupae age at the time of treatment, male flies being more sensitive than females to gamma-rays. Adult male flies irradiated with 8,000 to 16,000 Rad soon after emergence also showed about a 95% reduction in fertility, but they lived as long as the untreated flies. Sterility was permanent during 45-day test periods. The sperm from irradiated males were motile and apparently behaved normally, and insemination was good. Laboratory and field cage trials indicated that irradiated males could compete successfully with untreated males and reduce reproduction from untreated female flies. Present difficulties in breeding the number of tsetse flies necessary for a practical sterile-male release program are being investigated in the Zambezi Valley, but it is too early to indicate success. The possibility of concentrating the breeding of a natural fly population is being explored by localizing cattle as a food source within the bush. Cement pipes are being used to simulate natural laviposition sites in an attempt to concentrate breeding. Eight-feet-high, quarter-acre wire-mesh cages enclosing the lower bush canopy, a 30-feet-high cage round an evergreen tree, and a variety of smaller wire-mesh and cement brick cages exposed to variable field, and relatively constant, climates have been erected to study fly survival and reproduction. Oxen are usually employed as the host in these cage trials but a separate study will compare survival and reproduction obtained from a variety of indigenous and domestic animals. These sterilization and breeding projects are supported by more than one million pupae collected by and knowledge gained from Dr. Phelps' associated study of natural breeding sites used during the year. (auth)

34809 POSSIBILITIES OF THE STERILE-MALE TECHNIQUE FOR THE CONTROL OF LIVESTOCK INSECTS IN THE UNITED STATES OF AMERICA. Graham, O. H.; Drummond, R. O.; Hoffman, R. A. (Agricultural Research Service, Kerrville, Tex.). pp 41-4 of Control of Livestock Insect Pests by the Sterile-Male Technique. Vienna; International Atomic Energy Agency (1968).

From Panel on the Control of Livestock Insect Pests by the Sterile-Male Technique, Vienna, Austria. See STI/PUB–184; CONF–670125.

Radiation and chemosterilant research on various livestock pests in the United States is reviewed from the standpoint of control by the sterile-male technique. Insects discussed are the screwworm flies (Cochliomyia hominivorax), the cattle grubs (Hypoderma sp.), the horn flies (Haematobia irritans), the stable flies (Stomoxys calcitrans), and the ticks (Amblyomma sp.). (H.L.W.)

34810 CURRENT STATUS OF SCREW-WORM ERADICATION IN THE SOUTH-WESTERN UNITED STATES OF AMERICA

AND THE SUPPORTING RESEARCH PROGRAM. Hightower, B. G.; Graham, O. H. (Agricultural Research Service, Kerrville, Tex.). pp 51-4 of Control of Livestock Insect Pests by the Sterile-Male Technique. Vienna; International Atomic Energy Agency (1968).

From Panel on the Control of Livestock Insect Pests by the Sterile-Male Technique, Vienna, Austria. See STI/PUB-184; CONF-670125.

The supporting research program on screw-worm eradication in the southwestern United States of America is described, the emphasis being on the current need to integrate into the fly release program a thorough knowledge of factors not previously encountered. (auth)

34811 PRELIMINARY RESULTS OF A GAMMA-IRRADIATION TEST ON PUPAE AND ADULT MALES OF GLOSSINA MORSITANS MORSITANS. Itard, J. (Institut d'Elevage et de Medecine Veterinaire des Pays Tropicaux, Maisons-Alfort, France). pp 59-63 of Control of Livestock Insect Pests by the Sterile-Male Technique. Vienna; International Atomic Energy Agency (1968). (In French).

From Panel on the Control of Livestock Insect Pests by the Sterile-Male Technique, Vienna, Austria. See STI/PUB-184; CONF-670125.

Pupae of Glossina morsitans morsitans of various ages and 24-hour-old males were exposed to different irradiation doses (^{137}Cs). Results presented show the percentage of hatchings and the fertility of adults from irradiated pupae, and the survival and fertility of irradiated adult males. (auth)

34812 ADVANCES IN FOOD RESEARCH. VOLUME 17. Chichester, C. O.; Mrak, E. M.; Stewart, G. F. (eds.). New York; Academic Press Inc. (1969). 309p. $14.50.

Separate abstracts were prepared for two sections of the book. Other sections are oxidation systems in fruits and vegetables—their relation to the quality of preserved products and the utilization of food industries wastes. A subject index is provided. (C.O.)

For abstracts of individual sections see: 34385 and 34813.

34813 TROPICAL FRUIT TECHNOLOGY. Czyhrinciw, N. (Central Univ., Maracay, Venezuela). Advan. Food Res.; 17: 153-214(1969).

Food technology, particularly as it relates to tropical fruits, is reviewed. The significance of fruits to man and his culture is discussed and definitions of fruit are given. Characteristics of fruits that are discussed are: morphology and anatomy; physical properties; some chemical properties (color, aroma, and flavor; vitamins and mineral salts; carbohydrates, proteins, fats, and caloric value; and enzymes). Some of the technical problems discussed are: preservation of fresh fruits and freezing; separation of the inedible part (skin); obtaining juices, pulps, and concentrates; dehydrated products; sweet products; fermentation products-alcoholic and acetic; age of elaborated products; and preservation by irradiation (discussed only briefly as a promising development). (C.O.)

34814 AN AUTOMATIC SAMPLING SYSTEM FOR RESPIRATORY GASES AND RESPIRATORY RESPONSE OF IRRADIATED CITRUS FRUIT. Green, G. F.; Ahmed, E. M.; Dennison, R. A. (Univ. of Florida, Gainesville). J. Food Sci.; 627-9(Nov-Dec 1969).

An automatic continuous-flow sampling system for monitoring respiratory gas was developed. Continuous airflow at constant pressure and temperature was pumped through 24 chambers. The airflow was regulated by needle valves connected to 3-way solenoids which sequentially switched the sample of a CO_2 infrared analyzer and recorder. A timing cycle was selected so that each sample was analyzed every 3 hr. The recorder was calibrated to read directly in percent CO_2. Results were expressed as ml CO_2/kg product/hr. The system was used to determine the respiratory activity of irradiated and nonirradiated citrus fruits. Irradiated fruits exhibited marked increases in CO_2 production reaching a maximum 1 to 2 days after treatment then gradually declining. Waxing limited the production of CO_2 especially with irradiated fruits. All fruits were treated with sulfanilamide to prevent post irradiation infection by mold. (auth)

34815 A REPORT ON THE STERILIZATION OF SURGICAL CATGUTS BY THE APPLICATION OF GAMMA RADIATION. Majid, Abdul; Mohiuddin, Mirza; Hamid, Muhammad Abdul (Atomic Energy Centre, Lahore). Sci. Ind. (Karachi); 6: 368-72(Oct 1968).

The sterilization dose of the locally manufactured catguts was found to be 2.5 megarads. Studies on the change in tensile strength and the period of absorption in animal tissue showed that the radiation of catguts with the sterilization dose of 2.5 megarads caused no change in these respects. (auth)

34816 IRRADIATION STABILIZATION OF PARTIALLY DEHYDRATED MEAT. Shults, Gary W. (to Secretary of the Army). U. S. Patent 3,493,397. 3 Feb 1970. Filed 28 Jun 1967.

A process is described whereby fresh and prepared meat items are partially dehydrated, sealed within containers, subjected to a sterilizing dose of ionizing radiation, and in the case of fresh meat items are subsequently blanched within the container. (Official Gazette)

34817 IRRADIATION OF FOOD. Hansen, Poul-Ivar-E. (Slagteriernes Forskningsinstitut, Roskilde, Denmark). Sciences (Paris); 10: 74-81(Jan-Apr 1969). (In French).

A general review of radiation techniques in nutrition is given as background for the observation that France has approved preservation of potatoes by γ irradiation at the same time as the U. S. has withdrawn its approval of similar preservation of bacon. Fundamentals of the interaction of radiation with matter are given, and the effects of ionizing radiation, particularly biological effects, are catalogued. Controls on irradiation such as biotoxicological security, nutritive value of foods, and microbiological security are noted. Use of irradiation as a complement to refrigeration, or as an autonomous method, is discussed; applications of both in preservation of food such as smoked ham, potatoes, onions, papayas, various foods for animals, and fish have been studied. A review of the progress in various countries testing radiation in food technology (U.S.S.R., Canada, U. S., Israel, France, and Holland) is made, particularly with respect to inactivation of bacteria. (BBB)

34818 STERILIZATION OF LABORATORY ANIMAL DIETS USING GAMMA RADIATION. Ley, F. J. (United Kingdom Atomic Energy Authority, Wantage, Eng.); Bleby, J.; Coates, Marie E.; Paterson, J. S. Lab. Anim.; 3: 221-54(Oct 1969).

Sterilization by γ radiation proved to be a suitable method for the treatment of a variety of laboratory animal diets intended for specified-pathogen-free (SPF) and germ-free colonies. Due to the high penetrating power of this radiation the diets can be packed before treatment in a manner that prevents recontamination during transport and storage. The main bulk of diets is used for SPF animals and a radiation dose of 2.5 Mrad proved effective for the control of contaminating organisms. No adverse effects on animals receiving the diets were noted, observations having been made on growth, reproduction and general health. Irradiated diets formulated according to current laboratory animal practice appear to be nutritionally satisfactory. (auth)

34819 EFFECT OF GAMMA RADIATION ON HARICHAL BANANAS. Ali, Mumtaz; Sattar, Abdus; Muhammed, Amir (Atomic Energy Centre, Lahore). Sci. Ind. (Karachi); 6: 381-7(Oct 1968).

Irradiation of mature green bananas of the Harichal variety with gamma radiation, up to 80 Krad, did not cause appreciable delay in ripening of the fruit. There was also no change in the vitamin C, protein, and sugar contents of bananas as a result of irradiation. The inner flesh of the irradiated samples was in a slightly better condition than the untreated fruits, after 13 days' storage of bananas, whereas there was no difference in the skin color. (auth)

34820 PACKAGING PROBLEMS IN FOOD PRESERVATION BY IRRADIATION. Mehringer, W. (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe, Ger.). Fette-Seifen-Anstrichm.; 71: 516-21(Jun 1969). (In German).

The radiation-stability of various packaging materials that might be used in food irradiation processing is reviewed, along with other aspects of this method of food preservation. In the preservation of foodstuffs by irradiation, differentiation is made between sterilization and pasteurization. Accordingly, requirements to be met by the packaging materials are different. The suitability of various materials as well as some technological problems associated with the usual sources of irradiation is discussed. The basic problems of microbiological equilibrium after irradiation are explained. In addition to the resistance of individual plastic materials to radiation, the problems involved in the detection of irradiation and induced radioactivity are dealt with. The transfer of foreign substances from the packaging material to the foodstuff is also considered. The amounts of gas produced by 6-Mrad irradiation of different foil wrappers are tabulated, as are taste changes induced in raw and cooked fish-fillets wrapped in foil sacks and irradiated with 1 to 16 Mrad. (BBB)

34821 SOME OBSERVATIONS ABOUT THE ^{60}Co-RADIATION ON WINE. Bulumac, Petre (Landwirtschaftliche Institut, Bucharest). Z. Lebensm.-Untersuch. Forsch.; 141: 193-6(1969). (In German).

The action of the γ radiations of ^{60}Co upon some wines from Romania, was studied employing relatively high irradiation doses

in order to produce extreme effects that were tested by sensoric and chemical analysis. By means of irradiation, some obvious changes of wine color, clarification, flavor and taste, were observed. From analysis, some changes were found in the concentration of the tanning and coloring substances, in the content of SO_2 and in the enzyme activity. There was no change of pH and no emergence of a remanent radioactivity. Treatment with γ radiations of ^{60}Co can be applied both to improve some defects and to obtain some traditional types of wine. (auth)

34822 RADIATION PRESERVATION OF FISH. I. GWYNIAD. Ehlermann, D.; Muenzner, R. (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe, Ger.). Z. Lebensm.-Untersuch. Forsch.; 141: 196-200(Dec 1969). (In German).

Freshly caught, whole gwyniads (Coregonus Wartmanni Bloch) from Lake Constance were packed in plastic films impermeable to oxygen and water vapor, irradiated with 10 MeV-electrons and stored under wet ice. Samples were examined for organoleptical, chemical and microbiological quality during six weeks. Shelflife of unirradiated controls was nine days, a dose of 100 krad prolonged shelflife to 23 days. Samples irradiated with 200 or 400 krad spoiled even later, but these higher doses caused off-flavor. (auth)

34823 STERILIZING BY RADIATION IN PHARMACEUTICAL INDUSTRY. Hangay, Gyoergy. Magy. Kem. Lapja; 24: 505-12 (Oct 1969). (In Hungarian).

A new method of sterilizing as applied in the pharmaceutical industry is described. The bactericidal effect of radiation is treated first, along with the physical and chemical changes caused in pharmaceutical preparations by radiation. The advantages of the new technology are summarized briefly, then a detailed description is given of the results achieved by radiation sterilization abroad and in Hungary, with special regard to the experiments made in the Pharmaceutical Works, Köbánya, Budapest during the past five years. Some economics questions are also treated. (auth)

34824 APPLICATION OF ATOMIC ENERGY IN THE PRESERVATION OF FRESH FRUITS AND VEGETABLES. Mathur, P. B. (Central Food Technological Research Inst., Mysore, India). Indian Food Packer; 22: 4-5(1968).

The salient features of the work done to extend the storage lives of fresh fruits and vegetables (e.g., potato, onion and garlic, tomato, banana, and mango) using Co-60 γ rays are described. (Indian Sci. Abstr.)

34825 FIELD RELEASES OF CODLING MOTHS STERILIZED BY TEPA OR BY GAMMA IRRADIATION, 1964-67. Butt, B. A.; Hathaway, D. O.; White, L. D.; Howell, J. F. (Agricultural Research Service, Yakima, Wash.). J. Econ. Entomol.; 63: 912-15 (Jun 1970).

Methods of sterilizing and releasing adult Laspeyresia pomonella (L.) were evaluated in 1964-67 prior to projected large-scale releases planned to test population control. Thus the moths were first chemosterilized with tepa by dipping (1964), by topical application (1965), and by aerosol spray (1966); then after mid-1966, they were irradiated with a cobalt-60 source. In 1967, the method of irradiation was altered by cooling the cobalt source to inactivate the moths instead of using CO_2. Releases were made by hand (1964-66) and by helicopter (1967). In 1964-66, only males were released: 97,797 in 12 acres in 1964; 411,210 in 6 acres in 1965; and 580,344 in 15 acres in 1966. In 1967, both sexes were released: 1,541,754 in 93 acres. An abandoned orchard was used for the 1964 and 1965 tests; commercial orchards were used in 1966 and 1967. The degree of control of the native population by releases made in commercial orchards was comparable to that obtained in similar orchards treated with insecticides. (auth)

34826 ELIMINATION OF SALMONELLA IN POULTRY WITH IONIZING RADIATION. Licciardello, J. J.; Nickerson, J. T. R.; Goldblith, S. A. (Massachusetts Inst. of Tech., Cambridge). Contracts AT(30-1)-3727; AT(30-1)-3325. pp 1-28 of Elimination of Harmful Organisms from Food and Feed by Irradiation. Vienna; International Atomic Energy Agency (1968).

From Panel on Elimination of Harmful Organisms from Food and Feed by Irradiation, Zeist, Netherlands. See STI/PUB-200; CONF-670671.

The radioresistance of Salmonella typhimurium in comminuted chicken meat was not affected by the breed of poultry (three different breeds tested) or by the type of meat (white or dark). A factor that did influence radioresistance was the temperature during irradiation. A difference in radioresistance was noted among five Salmonella serotypes tested. S. oranienburg was the most resistant and S. newport was the least resistant whereas S. thompson, S. heidelberg and S. typhimurium were intermediate. Of the salmonellae that survived irradiation in the non-frozen state, only an insignificant number were inactivated during subsequent quick-freezing and the concentration remained relatively constant over a three-month storage period at 0°F. Thus, salmonellae that have been irradiated (in chicken meat) do not appear to be any more susceptible to freezing injury compared with non-irradiated salmonellae. The psychrophiles in comminuted whole chicken meat surviving irradiation (300 krad) were a mixture of yeasts and members of the Achromobacter-Alicaligenes groups. In quantitating salmonellae surviving irradiation in chicken meat by the plate count method, the greatest recovery was obtained with tryptic soy yeast extract agar. Repeated irradiation and subculturing of survivors produced a population of Salmonella with increased radioresistance. Cells in the stationary phase of growth (24 h) were more radioresistant than cells in the logarithmic phase (7 h). The growth rate of the radioresistant cells at 98.6°F (37°C) did not differ from that of the parent strain. (auth) (TSS)

34827 IONIZING RADIATION FOR THE ELIMINATION OF SALMONELLAE FROM FROZEN MEAT. Ley, F. J. (Atomic Energy Research Establishment, Wantage, Eng.). pp 29-35 of Elimination of Harmful Organisms from Food and Feed by Irradiation. Vienna; International Atomic Energy Agency (1968).

From Panel on Elimination of Harmful Organisms from Food and Feed by Irradiation, Zeist, Netherlands. See STI/PUB-200; CONF-670671.

The radioresistance in frozen meat of a number of different serotypes of Salmonella was examined. A dose of 0.65 Mrad achieved a 10^6 reduction in the numbers of the most resistant types and this dose was shown to be effective in eliminating salmonellae from naturally contaminated meat. Some results are outlined which show that Salmonella resistance is higher in frozen meat than in unfrozen meat, pre-irradiation growth of the organisms in meat does not influence resistance, salmonellae surviving irradiation grow at a slower rate than unirradiated organisms and appear to be unchanged in serological properties or phage type. Reference is made to wholesomeness tests carried out on irradiated meat and to the current situation on legislation in the United Kingdom controlling the irradiation of food. The identification of irradiated food is also mentioned. (auth)

34828 RADIATION RESISTANCE OF SALMONELLAE AND THEIR OCCURRENCE IN THAILAND. Tanasugarn, L. (Kasetsart Univ., Bangkok). pp 37-41 of Elimination of Harmful Organisms from Food and Feed by Irradiation. Vienna; International Atomic Energy Agency (1968).

From Panel on Elimination of Harmful Organisms from Food and Feed by Irradiation, Zeist, Netherlands. See STI/PUB-200; CONF-670671.

Studies were undertaken to determine the salmonellae contamination of different food and feed products in Thailand. The radioresistance of different isolated strains was determined. Of the examined samples, 0.5% beef meat, 0.7% pork meat, 2.5% pork liver, 4% beef liver and 2% fish meal were contaminated with salmonellae. Salmonella derby and S. anatum were predominant. The D-values for different Salmonella serotypes in minced beef irradiated at 4 to 10°C varied from 27 to 50 krads. (auth)

34829 PROSPECTS FOR THE SALMONELLA RADICIDATION OF SOME FOODS AND FEEDS WITH PARTICULAR REFERENCE TO THE ESTIMATION OF THE DOSE REQUIRED. Mossel, D. A. A. (Central Inst. for Nutrition and Food Research TNO, Zeist, Netherlands); Van Schothorst, M.; Kampelmacher, E. H. pp 43-57 of Elimination of Harmful Organisms from Food and Feed by Irradiation. Vienna; International Atomic Energy Agency (1968).

From Panel on Elimination of Harmful Organisms from Food and Feed by Irradiation, Zeist, Netherlands. See STI/PUB-200; CONF-670671.

An estimation of the dose required for Salmonella radicidation of some foods and feeds is presented. In view of frequently observed tailing off of survivor curves, the parameter most probable effective dose (MPED) for a given number of decimal reductions in a particular substrate and at a given pO_2 and a_w is used. Two different approaches are followed in calculating dose requirements. In the first, called the comparative reduction rate principle, doses of γ radiation are calculated that will result in the same degree of reduction of counts of pertinent organisms as is obtained in the conventional processes already used for decontamination; or, if no such processes are used or known, in similar conventional treatments. In the other mode of approach, the choice of dose is made by taking into account the maximal initial count of salmonellae that might occur in the product, and the count to be obtained in a satisfactorily radicidized commodity. The latter figure is estimated on the basis of the modes of sampling and bacteriological examination used by the competent authority. In both types of estimates, the essential advantage of radiation processing is taken into account,

namely the possibility of treating already hermetically packaged products and hence preventing recontamination after processing. Radicidation of some at present heavily contaminated mixed feed ingredients, such as sun-dried fishmeal, bloodmeal and cottonseed meal, and of frozen chicken and boneless meats seems to offer very attractive possibilities. (auth)

34830 EFFECT OF IRRADIATION OF ANISAKIS LARVAE IN SALTED HERRING. Van Mameren, J.; Houwing, H. (Inst. for Fishery Products TNO, Ijmuiden, Netherlands). pp 73-80 of Elimination of Harmful Organisms from Food and Feed by Irradiation. Vienna; International Atomic Energy Agency (1968).

From Panel on Elimination of Harmful Organisms from Food and Feed by Irradiation, Zeist, Netherlands. See STI/PUB-200; CONF-670671.

Experiments to test the practicability of using irradiation to kill Anisakis marina larvae in lightly salted herring (Clupea harengus) are described. The lower salt concentration used since the Second World War for the preservation of gibbed herring is insufficient to kill the parasites that may be harmful to the consumer. The nematodes were subjected to irradiation, either in water or saline suspension, or pressed between salted herring fillets or in situ in salted gibbed herring. The results were disappointing. In aqueous suspensions, a salt concentration of 6% and a dose of 1.0 Mrad resulted in 100% mortality, but appreciable numbers survived (although many of these were inactive) at lower irradiation doses and at lower salt concentrations. It was noted that for doses of either 0 or 0.3 Mrad the greatest survival occurred in 3% salt solutions. In testing the effect of irradiation on parasites in the fish or placed between fillets the doses were limited, because of flavor and color changes, to 0.3 Mrad for salted ripened herring, and 0.6 Mrad for 5-day-old lightly salted herring. Substantial numbers of nematodes survived these doses. (auth)

34831 GAMMA IRRADIATION ELIMINATION OF CYSTICERCUS BOVIS IN MEAT. Van Kooy, J. G. (EURATOM-ITAL, Wageningen, Netherlands); Robijns, K. G. pp 81-9 of Elimination of Harmful Organisms from Food and Feed by Irradiation. Vienna; International Atomic Energy Agency (1968).

From Panel on Elimination of Harmful Organisms from Food and Feed by Irradiation, Zeist, Netherlands. See STI/PUB-200; CONF-670671.

In some developing countries taeniasis and cysticercosis are considered among the more grave parasite diseases. Some regions are believed to have an infection as high as 80%. To combat cysticercosis one is confined to the inspection of slaughtered cattle. Cysts in meat can be eradicated by heat as well as by cold. A heat treatment devaluates the meat, and freezing methods appear to be too expensive for developing countries. For this reason destruction by irradiation seems to be interesting. No clear conclusions about the lethal dose of Cysticercus bovis can be found in the literature. A direct inactivation of the parasite requires more than 300 krad. A combined treatment of a 300 krad and a minimum storage of 7 days at 2°C is fatal for cysts in beef. (auth)

34832 PROSPECTS FOR THE ELIMINATION OF CLOSTRIDIUM BOTULINUM FROM FISH AND FISHERY PRODUCTS BY IRRADIATION. Hobbs, G. (Ministry of Tech., Aberdeen, Scotland). pp 101-7 of Elimination of Harmful Organisms from Food and Feed by Irradiation. Vienna; International Atomic Energy Agency (1968).

From Panel on Elimination of Harmful Organisms from Food and Feed by Irradiation, Zeist, Netherlands. See STI/PUB-200; CONF-670671.

The occurrence of Clostridium botulinum in fish and fishery products and its resistance to irradiation is discussed. Different possible irradiation treatments such as radappertization, radurization and combined processes are considered. For Great Britain it is suggested that sea-frozen fish should be thawed, filleted, packaged and irradiated at 0.3 Mrads. This irradiation treatment would give a sufficient extension of the market life. To eliminate the botulism hazard a temperature of less than 5°C for storage and distribution is recommended. (auth)

34833 PECTIN CHANGES IN THE RIPENING OF IRRADIATED AND STORED STRAWBERRIES. Belli-Donini, M. L.; Stornaiuolo, M. R. (CNEN, Rome). J. Food Sci.; 34: 509-14(Nov-Dec 1969).

Strawberries of the Red Gauntlet variety picked at two different stages of maturation were irradiated with a ^{60}Co γ source at 200 krads. After irradiation the fruits were stored in a refrigerated cell at a temperature varying from 0 to 3°C and at a relative humidity between 85 and 90%. During the storage a part of the control berries was irradiated at different times to find out differences in irradiation response at successive stages of ripeness in storage conditions. The effects of irradiation on the pectic substances, pectin methylesterase activity and anthocyanin content were investigated. In addition, changes in softening and extent of fungal growth were followed. A different response of strawberries irradiated at two different stages of ripeness was found. The different ripeness in storage conditions also influenced the radiation response of the strawberries. The possible practical applications of these findings are discussed. (auth)

34834 RADIATION INACTIVATION OF SOME SPOILAGE FUNGI OF STORED RICE. Chowdhury, S. U.; Hossain, M. M. (Atomic Energy Centre, Dacca, Pakistan). Sci. Ind. (Karachi); 6: 364-7(Oct 1968).

Six species of fungi associated with the spoilage of stored rice in East Pakistan were subjected to gamma radiation from a ^{60}Co source to determine the doses required for their inactivation in situ and in isolation. When plated immediately after irradiation, the doses required for the inactivation of fungi in situ ranged from 175 krad to 200 krad and in isolation, from 170 krad to 185 krad, depending on the species. But when the fungi were transferred to the nutrient medium 24 hours after irradiation, the inactivation doses in situ ranged from 170 krad to 195 krad and in isolation from 158 krad to 185 krad, depending on the species of the fungi tested. (auth)

34835 STERILIZING DOSES OF GAMMA IRRADIATION FOR THE IMPORTED CABBAGEWORM, PIERIS RAPAE, AND EFFECTS ON LONGEVITY, MATING, AND FECUNDITY. Flint, Hollis M.; Spencer, Neal (Agricultural Research Service, Fargo, N. Dak.). J. Econ. Entomol.; 63: 1008-9(Jun 1970).

Adult butterflies were collected and γ-irradiated 36 hr after emergence from pupae and placed with unirradiated butterflies of the opposite sex in a ratio of two males to one female. Data were collected on mortality, mating, oviposition, hatching, and lifespans. No difference was found in the average number of eggs per female when unirradiated females were caged with either irradiated or unirradiated males. However, irradiation of females caused a significant reduction of oviposition. The lifespans of irradiated females were not different from those of controls; however, irradiated males had significantly shorter lifespans than controls. Males were sterilized by a 40 krad dose, while females were sterilized by a 20 krad dose. (H.L.W.)

34836 HAS FOOD IRRADIATION REACHED SIGNIFICANCE YET? Wiesner, L. Atomwirt., Atomtech.; 15: 293-6(Jun 1970). (In German).

Economical and political significance of food preservation by irradiation are reviewed from a worldwide as well as a German national standpoint. As far as Germany is concerned, irradiation of fish and poultry is most promising. Market introduction of irradiated food is delayed chiefly because of legal licensing requirements. Generally, these requirements parallel those for chemical food additives. However, chemical additives can be easily determined, while radiation-induced changes escape detection. From a world trade standpoint, establishment of an international organization is proposed for supervision of food irradiation. (H.B.G.)

METALS, CERAMICS, AND OTHER MATERIALS

Metals and Alloys

34837 (BMBW-FBK-70-1) EUROPEAN CONFERENCE ON THERMOPHYSICAL PROPERTIES OF SOLIDS AT HIGH TEMPERATURE, 11–13 NOVEMBER 1968, BADEN-BADEN. (Deutsche Keramische Gesellschaft e. V., Bad Honnef (West Germany)). Feb 1970. 677p. (In several languages). (CONF-681116). ZAED DM 142.20.

Forty papers were presented at the conference. A separate abstract was prepared for each of fifteen papers. Two papers were previously abstracted in NSA as 23: 18207 and 23: 18208. Other papers presented at the conference are not in the scope of NSA. (J.R.D.)

For abstracts of individual papers see: 33824, 33825, 34870–33877, 34944–34947, and 34978.

34838 (BMI-1882) PROGRESS ON DEVELOPMENT OF MATERIALS AND TECHNOLOGY FOR ADVANCED REACTORS DURING JANUARY–MARCH 1970. Quarterly Report, Tasks 6, 7, 14, and 32. Keller, Donald L. (Battelle Memorial Inst., Columbus, Ohio). Apr 1970. Contract W-7405-eng-92. 79p. Dep. CFSTI.

Research and development results are presented in four sections. A separate abstract was prepared for each section. (J.R.D.)

For abstracts of individual sections see: 34878, 34921, 34969, and 34970

34839 (BNWL-1091) IRRADIATION EFFECTS ON REACTOR STRUCTURAL MATERIALS. Quarterly Progress Report, February–April 1969. Claudson, T. T. (ed.) (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). June 1969. Contract AT-(45-1)-1830. 318p. Dep. CFSTI.

Research and development conducted at Argonne National Laboratory, Battelle Memorial Institute, Gulf General Atomic, Incorporated, Idaho Nuclear Corporation, Naval Research Laboratory, Oak Ridge National Laboratory, and Pacific Northwest Laboratory are summarized. (J.R.D.)

34840 (BNWL-1349-1) REACTOR FUELS AND MATERIALS DEVELOPMENT PROGRAMS FOR FUELS AND MATERIALS BRANCH OF USAEC DIVISION OF REACTOR DEVELOPMENT AND TECHNOLOGY. Quarterly Progress Report, January–March 1970. Sheely, W. F. (ed.) (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Apr 1970. Contract AT(45-1)-1830. 316p. Dep. CFSTI.

Results of research and development are reported in eight sections. A separate abstract was prepared for each section. (J.R.D.)

For abstracts of individual sections see: 33849, 34843, 34922, 34923, and 34971–34974.

34841 TUNGSTEN NEWS. JUNE 1970. Tungsten News; 1-16(Jun 1970).

Activities associated with the development and use of W are reviewed. A brief review of a metallurgical conference held in the UK in April 1970 is presented. The conference was devoted to information associated with mechanisms of tool failure, tool materials, and users views. Other items of related to current interest in W development are also reviewed along with news concerning WC, W-base alloys, and properties of W as an alloying element. (222 references are included.) (J.R.D.)

34842 PLUTONIUM-DOKUMENTATION. Referate-Zeitschrift mit Anhang Transplutonium-Elemente. Mai 1970. Band 4, Heft 5. 192 Referate (Register-Nr. 1415-1788). (Plutonium-Documentation. Abstract Journal with Appendix on Transplutonium Elements. May 1970. Vol. 4, No. 5. 192 Abstracts (Register No. 1415-1788)). Karlsruhe, Ger.; Gesellschaft fuer Kernforschung m.b.H. (1970). 115p. (In German and English).

Corrosion and Erosion

Refer also to abstracts 33838 and 36043.

34843 (BNWL-1349-1, pp 9.1) ATR WATER LOOP OPERATION AND MAINTENANCE. Hope, R. S. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

From Reactor Fuels and Materials Development Programs for Fuels and Materials Branch.

Details of corrosion loop operation and maintenance during the report period are given. 168 stainless steel coupons and 84 Zircaloy specimens were exposed during the period. (J.R.D.)

34844 (LA-4363-TR) PROTECTION OF URANIUM BY METALLIC COATINGS. Baque, Pierre; Koch, Phillipe; Dominget, Raymond; Darras, Raymond (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Translated for Los Alamos Scientific Lab., N. Mex., from report CEA-R-3638. 21p. Dep. CFSTI.

This paper was abstracted from the original language and appears as 23: 22463. (J.R.D.)

34845 (LA-4413-TR) NEW CORROSION-RESISTANT ZIRCONIUM–TANTALUM ALLOYS. Andreeva, V. V.; Chekhovskii, S. V.; Dontsov, S. N.; Moiseeva, I. S.; Klinov, I. Ia. Translated by Anna Vakar (Los Alamos Scientific Lab., N. Mex.), from Byull. Tekh.-Ekon. Inform., Gos. Nauch.-Issled. Inst. Nauch. Tekh. Inform.; 20: No. 5, 14-16(1967). 3p. Dep. CFSTI.

Zirconium and tantalum alloys have been developed to increase zirconium's corrosion resistance in those H_2SO_4 solutions in which it is unstable. After annealing, the alloys had a two-phase structure. The alloy compositions, chemical analyses, conditions of thermal treatment, and mechanical properties are given. The corrosion rate decreases with increased tantalum content. All the metals and alloys tested have great chemical stability at 20 to 80° in $\leq 75\%$ H_2SO_4 solutions. Alloys containing 40% or more of tantalum are stable in 80% H_2SO_4 at 40°, while those with $\leq 50\%$ tantalum are stable in 85% H_2SO_4. X-ray diffraction analysis of the film formed on the zirconium during its anodic polarization in H_2SO_4 solutions showed that both the black and gray films are ZrO_2 in its different modifications. The transition from the black to the gray oxide is the result of phase transformation of ZrO_2 from the hexagonal to the monoclinic. To increase the corrosion resistance of zirconium, it is necessary to stabilize the most stable modification of ZrO_2. Alloying zirconium with tantalum can both sharply reduce and completely prevent the solution of zirconium in strong H_2SO_4 solutions, depending on the acid concentration and temperature. An alloy containing 50 to 60% of tantalum has high corrosion resistance in concentrated H_2SO_4 solutions at 100 to 120°. (auth)

34846 (ORNL-TM-2978) COMPATIBILITY OF FUSED SODIUM FLUOROBORATES AND BF_3 GAS WITH HASTELLOY N ALLOYS. Koger, J. W.; Litman, A. P. (Oak Ridge National Lab., Tenn.). Jun 1970. Contract W-7405-eng-26. 20p. Dep. CFSTI.

Corrosion by $NaBF_4$-NaF mixtures (4 to 8 mole % NaF) low in oxygen and water was studied with 6800-hr static tests at 605°C in standard Hastelloy N capsules with titanium-modified Hastelloy N specimens. Boron trifluoride gas was added to overpressures up to 400 psig. Specimens in the molten salts and at the interface showed both weight gains and losses. The gains decreased with increasing $NaBF_4$ content, and losses up to 0.03 mg/cm^2 (<0.01 mil/year) were observed for specimens in 4 mole % NaF. Weight changes of specimens in vapor were very small and independent of overpressure. The main reaction was the oxidation of chromium in the alloy by iron fluoride in the salt to form Na_3CrF_6 and deposit iron on both specimens and capsule. Metallographic examination showed only minor attack and no difference in the two Hastelloy N alloys. The rate of chromium depletion at 605°C was consistent with the rate of solid-state diffusion of chromium to the alloy surface. Additional tests from 538 to 760°C showed Arrhenius behavior that confirmed this mechanism. Fluoroborate salt mixtures were found compatible with Hastelloy N alloys under the conditions of these experiments, and comparison with other experiments showed that increases in water and oxygen content increased the chromium uptake and corrosion. (auth)

34847 (WAPD-TM-754) FURTHER STUDIES DEFINING THE AQUEOUS CORROSION PERFORMANCE OF A ZIRCONIUM–NIOBIUM–COPPER ALLOY. Kass, Stanley (Bettis Atomic Power Lab., Pittsburgh, Pa.). Apr 1970. Contract AT(11-1)-Gen-14. 14p. Dep. CFSTI.

Additional experiments were performed to further explore the influence of heat treatment upon the corrosion performance of a Zr + 2.5% Nb + 0.5% Cu alloy. Heat treating in the alpha-plus-beta region followed by rapid cooling to room temperature and a subsequent anneal at 1000°F yielded a material with high corrosion resistance in 600 and 680°F water. The corrosion resistance increased with increasing cooling rate from the $\alpha + \beta$ region prior to the α anneal. On the other hand, hydrogen pickup was found

to increase with increasing cooling rate. The hydrogen absorption rate of the material heat treated for high corrosion resistance was found to be particularly poor in 600°F water. (auth)

34848 MECHANISM OF THERMAL DESORPTION OF OXYGEN ON THE (100) FACE OF A TUNGSTEN CRYSTAL. Zingerman, Ya. P. (Inst. of Physics, Kiev). Sov. Phys.-Solid State (Engl. Transl.); 11: 3038-40(Jun 1970).

Translated from Fiz. Tverd. Tela; 11: 3621-4(Dec 1969).

The kinetics of the thermal desorption of O_2 from the W(100) face was studied at temperatures ≤1400°K using changes in the work function during isothermal heating, and at temperatures ≥1400°K using the ionization current of desorbed O_2. Two separate peaks were found in the desorption process, which is reversible. The reason for the thermal desorption is the rearrangement process. The various processes involved in the desorption are discussed. (D.L.C.)

34849 OXYGEN EMBRITTLEMENT OF ZIRCONIUM–COPPER ALLOYS AT HIGH TEMPERATURES. Kaden, W.; Debray, W. (Siemens Aktiengesellschaft, Erlangen, Ger.). ASTM (Amer. Soc. Test. Mater.) Spec. Tech. Publ.; No. 458, 179-93 (1969).

From Symposium on Applications-Related Phenomena in Zirconium and Its Alloys, Philadelphia, Pa. See ASTM-STP-458; CONF-681105.

Zirconium alloys exposed to temperatures above 450°C in oxygen-containing atmospheres will be subject to oxygen diffusion from the oxide layer into the metal. An oxygen-enriched zone was formed having a lower ductility than the metal in the initial stage and therefore was susceptible to cracks. The uptake of oxygen by the metal and the thickness of the oxygen-enriched zone were measured as a function of oxidation time and temperature. The results showed that the mechanical properties of the metal as a function of temperature and oxygen content agreed well with the observation that the formation of cracks stopped when the crack end reached a layer of reduced oxygen concentration and consequently increased ductility. (auth)

34850 CORROSION BEHAVIOR OF 2.5Nb ZIRCONIUM ALLOY. LeSurf, J. E. (Atomic Energy of Canada Ltd., Chalk River, Ont.). ASTM (Amer. Soc. Test. Mater.) Spec. Tech. Publ.; No. 458, 286-300(1969).

From Symposium on Applications-Related Phenomena in Zirconium and Its Alloys, Philadelphia, Pa. See ASTM-STP-458; CONF-681105.

The heat-treatable 2.5 Nb–Zr alloy is of interest to nuclear reactor designers because it has greater strength than the Zircaloys. Its corrosion behavior was affected by its metallurgical structure, the chemical composition of the environment, and the presence of reactor radiation. Desirable mechanical properties were obtained by quenching from a temperature high in the ($\alpha + \beta$)-phase region (generally 850 to 880°C) and stabilizing the structure by aging in the α-phase region (500 to 575°C). Cold work between quenching and aging enhanced some properties, notably corrosion resistance. This was illustrated by results of corrosion experiments in aqueous and gaseous media. The corrosion resistance after different amounts of cold work and aging might be correlated with the sub-microstructure developed, as shown by electron microscopy. Evidence from several independent experiments showed that the alloy was much less sensitive to radiation enhancement of corrosion than is Zircaloy, even under strongly oxidizing conditions, such as neutral boiling water. In many cases the oxidation in-flux was less than that out-of-flux in the same coolant stream. The 2.5 Nb–Zr alloy has found nuclear application as pressure tubes for heavy-water moderated reactors, both with pressurized water and boiling water coolant, and as fuel cladding in organic coolant. Results of irradiation experiments suggest it would be useful as fuel cladding in boiling-water-cooled reactors and for conditions which exceed the upper temperature limit of Zircaloy cladding. (auth)

34851 OZHENNITE 0.5: ITS POTENTIAL AND DEVELOPMENT. Boulton, J.; Wright, M. G. (Atomic Energy of Canada Ltd., Pinawa, Man.). ASTM (Amer. Soc. Test. Mater.) Spec. Tech. Publ.; No. 458, 325-37(1969).

From Symposium on Applications-Related Phenomena in Zirconium and Its Alloys, Philadelphia, Pa. See ASTM-STP-458; CONF-681105.

Results of corrosion tests on Ozhennite 0.5 in organic coolant and high-temperature steam are summarized. The alloy showed improved corrosion and hydriding resistance compared to that of the commonly known zirconium alloys, the Zircaloys and 2.5 Nb–Zr alloy. Its possible use as a pressure-tube and fuel-cladding material in organic-cooled, heavy-water moderated reactors and as fuel cladding in advanced boiling-water reactors is discussed and the development program initiated to investigate its behavior under service conditions in these systems outlined. Mechanical properties of Ozhennite 0.5 pressure tubing and fuel cladding made by commercial methods are presented. These showed that the alloy had similar mechanical strength to that of Zircaloy-2. (auth)

34852 OXIDATION OF Ta SINGLE CRYSTALS AND POLYCRYSTALS IN THE TEMPERATURE RANGE 850°C TO 1100°C. Dooley, R. B.; Stringer, J. (Univ. of Liverpool). Corros. Sci.; 10: 265-71(May 1970).

Single crystal cylinders of Ta have been oxidized in dry oxygen at approximately 700 torr in the temperature range 850 to 1100°C. At the lower temperatures the oxidation rate is more rapid over {110} planes, the scale showing shear failures associated with pores resulting from the oxidation of suboxide platelets, in agreement with earlier investigations. Above 950°C the anisotropy initially decreases and the porosity of the scale diminishes, although on metallographic grounds the suboxide plates are still regarded as isothermal features of the oxidation. This is attributed to increasing scale plasticity. In a narrow temperature range near 1025°C the shear failures are absent, and very rapid oxidation of {100} faces occurs, with the development of a porous oxide which again appears to have resulted from platelet induced porosity. It is suggested, again on metallographic grounds, that platelets are present isothermally below {100} surfaces, but not below {110} surfaces, although they are precipitated on cooling. Above 1050°C, all porosity disappears and the oxidation becomes isotropic. However, there is still some reason to believe that at least some of the suboxide platelets are isothermal. (auth) (UK)

34853 INFLUENCE OF METALLURGICAL CONDITION AND SURFACE FINISH ON THE HIGH TEMPERATURE OXIDATION BEHAVIOUR OF AUSTENITIC STAINLESS STEEL IN CO_2. Tripathi, K. C.; Antill, J. E. (Atomic Energy Research Establishment, Harwell, Eng.). Corros. Sci.; 10: 273-81(May 1970).

It has been shown that both metallurgical condition and surface finish may influence the oxidation behavior of a 20% Cr–25% Ni–Nb steel in CO_2 at 800°C for exposure periods up to 5000 hr. To a lesser extent surface finish also influences the behavior of a 20% Cr–25% Ni–0.1% Y–Nb steel at 800 and 900°C. For the Y-free steel a poor surface finish results in severe oxidation of large metal grains in addition to a general increase in the oxidation of fine grained areas. Poor behavior is associated with a final surface treatment involving SiC abrasion. Good results are obtained if the metal is given a final annealing treatment or is electropolished. The basic factors responsible for the differences in behavior are briefly discussed. (auth) (UK)

Preparation and Fabrication

34854 (RD/B/N-1663) CHEMICAL POLISHING OF IRRADIATED NICKEL AND STAINLESS STEEL. Harbottle, J. E. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). May 1970. 4p. Dep. CFSTI (U. S. Sales Only).

Oxides produced during reactor irradiation of bulk specimens of nickel and stainless steel were found to be more resistant to removal by electro- and chemical-polishing than the oxides on unirradiated material. A description is given of chemical polishing treatments for the irradiated metals that proved to be both rapid and effective. (auth) (UK)

34855 (SRO-475-7) POWDER METALLURGY COMPACTION. Quarterly Progress Report, March 1–May 31, 1970. Schwartz, E. G.; Wilson, Kenneth L.; Hornsby, James B. (South Carolina Univ., Columbia. Coll. of Engineering). Contract AT(38-1)-475. 13p. Dep. CFSTI.

Results of die vibration experiments indicate that superimposed vibrations can reduce die wall friction during a compaction if the amplitude of vibration is great enough. The criterion for minimum amplitude appears to be the average particle size of the material being compacted. A previous survey characterized the powder used as being .00173 inches in diameter or less (84% of sample), and amplitudes of .001 to .006 inches were required to observe die wall friction reduction. (J.R.D.)

34856 FABRICATION OF REFRACTORY METALS. Wilkinson, Walter D. New York; Gordon and Breach, Science Publishers, Inc. (1970). 439p. $21.00. (TID-25424).

Discussion and data on refractory metals and alloys are presented in eight chapters. A separate abstract was prepared for each chapter. (J.R.D.)

For abstracts of individual chapters see: 34857–34864.

34857 GENERAL FABRICATION CONSIDERATIONS. pp 1-62 of Fabrication of Refractory Metals. /Wilkinson, Walter D. New York; Gordon and Breach, Science Publishers, Inc. (1970).
See TID-25424.

Characteristics and parameters related to ductility of refractory metals are reviewed as these affect fabrication. Discussions are included on selection of a basic fabrication process, interstitial impurity effects, powder processing and casting, substitutional alloys, relations of purity and properties, relations of processing with purity, refining and consolidation, and fabrication methods. 65 references are included. (J.R.D.)

34858 DEFORMATION PROCESSING. pp 63-129 of Fabrication of Refractory Metals. /Wilkinson, Walter D. New York; Gordon and Breach, Science Publishers, Inc. (1970).
See TID-25424.

The goals of fabrication by deformation are to convert the alloy or metal from its crude form to the desired shape, and to conserve or impart desired properties to the product. Discussions are included on deformation rates, deformation processing flow sheets, and effects of operating conditions. Parameters of extrusion fabrication are discussed including methods and equipment, metal flow in extrusion, lubrication and protective coatings, conditions for extrusion of specific metals, forging methods, tube forming, rolling methods, and quality control. 64 references are included. (J.R.D.)

34859 VANADIUM. pp 130-59 of Fabrication of Refractory Metals. /Wilkinson, Walter D. New York; Gordon and Breach, Science Publishers, Inc. (1970).
See TID-25424.

Aspects of vanadium preparation and fabrication are reviewed. Discussions are included on separation and reduction, compaction and sintering, melting, extrusion, coating for protection, welding, extrusion of v-base alloys, and tube fabrication methods. 35 references are included. (J.R.D.)

34860 NIOBIUM (COLUMBIUM). pp 160-204 of Fabrication of Refractory Metals. /Wilkinson, Walter D. New York; Gordon and Breach, Science Publishers, Inc. (1970).
See TID-25424.

Aspects of niobium preparation and fabrication are reviewed. Discussions are included on niobium reduction and separation from tantalum, production of pure niobium, melting, coating niobium and its alloys, processing for fabrication, bonding, and fabrication methods. 90 references are included. (J.R.D.)

34861 TANTALUM. pp 205-29 of Fabrication of Refractory Metals. /Wilkinson, Walter D. New York; Gordon and Breach, Science Publishers, Inc. (1970).
See TID-25424.

Aspects of Ta preparation and fabrication are reviewed. Discussions are included on production of various forms of Ta, consolidation methods, methods of preventing corrosion and embrittlement, fabrication methods, and thermal treatments. 34 references are included. (J.R.D.)

34862 CHROMIUM. pp 230-50 of Fabrication of Refractory Metals. /Wilkinson, Walter D. New York; Gordon and Breach, Science Publishers, Inc. (1970).
See TID-25424.

Aspects of Cr fabrication and preparation are presented. Discussions are included on reduction methods, consolidation, purification methods, and fabrication methods. 35 references are included. (J.R.D.)

34863 MOLYBDENUM. pp 251-96 of Fabrication of Refractory Metals. /Wilkinson, Walter D. New York; Gordon and Breach, Science Publishers, Inc. (1970).
See TID-25424.

Aspects of Mo preparation and fabrication are reviewed. Discussions are included on processes involved in production of metal, consolidation, fabrication methods, corrosion protection, joining, and thermal treatments. 97 references are included. (J.R.D.)

34864 TUNGSTEN. pp 297-398 of Fabrication of Refractory Metals. /Wilkinson, Walter D. New York; Gordon and Breach, Science Publishers, Inc. (1970).
See TID-25424.

Aspects of W preparation and fabrication are reviewed. Discussions are included on processing W ores, methods of separating W from impurities, fabrication methods, W microstructure control methods, methods of joining W and its alloys, and refining methods. 122 references are included. (J.R.D.)

34865 GROWTH SPIRALS ON ELECTROLYTICALLY POLISHED SURFACES OF Mo SINGLE CRYSTALS. Yaroshevich, V. D.; Shakhalova, G. I. (Ioffe Inst. of Physics and Tech., Leningrad). Sov. Phys.-Solid State (Engl. Transl.); 11: 2998-9(Jun 1970).
Translated from Fiz. Tverd. Tela; 11: 3582-4(Dec 1969).

Growth spirals were observed with an optical microscope on Mo monocrystals after electropolishing for at least 3 hr. Interference measurements showed every spiral to be a cone pointing into the inside of the metal, the lateral surface to be a terrace formed by steps of equal size, and the height of each step to be $\sim 3 \times 10^4$ Å. There is no apparent connection with the dislocation structure, but the (110) plane behaves differently from the (100) and (111) planes. Some possible mechanisms for the spirals are discussed. (D.L.C.)

34866 PROBLEMS INVOLVED IN THE PREPARATION OF WELDED NIOBIUM ALLOY PIPES. Pavlov, I. M.; Rymov, V. A.; Sautin, Yu. I.; Izotov, V. M.; Krichevskii, E. M.; El'chaninov, V. N.; Nemtsov, A. S. Tsvetn. Metal.; 43: No. 3, 50-2(Mar 1970). (In Russian).

The low yield of acceptable products rendered seamless pipes made of thin sheets of niobium alloys too expensive; therefore a more economical process, based on welding was developed. Arc-melted niobium alloy ingots, containing titanium and zirconium, were used as the starting material. The thickness of the ingots was reduced by rolling from 60 to 10 mm. Welding equipment commonly employed for welding steel was also used for the niobium-alloy pipes, determining the best operating conditions on rods and sheets of the alloy. X-ray and metallographic tests revealed that the weldments were free of cracks, pores or other defects; argon arc welding techniques also yielded satisfactory results. Vacuum annealing of the metal reduced the mechanical strength by about 12 to 15% and increased the relative elongation by a factor of 1.5 to 2. The microhardness of the weldment and the base metal were identical. The cost of niobium-alloy pipes was thus reduced by a factor of 2 to 2.5 while increasing the dimensional accuracy of the product. (TTT)

34867 NIOBIUM AND VANADIUM REFINING ON AN INDUSTRIAL SCALE BY VACUUM MELTING IN AN ELECTRON BOMBARDMENT FURNACE. Charquet, D.; Vanlaer, M.; Verdet, A.; Durand, R. (Centre de Recherches, Brignoud, France). Mem. Sci. Rev. Met.; 67: 219-27(Mar 1970). (In French).

Molecular distillation is used in metal vacuum refining. Interstitials ($O_2 - N_2 - C$) at concentrations $<100 \cdot 10^{-6}$ and metallic impurities at concentrations $<50 \cdot 10^{-6}$ are removed in order to refine niobium. Niobium of purity higher than 99.985% could be prepared. Oxygen, carbon, silicon, nitrogen and iron were removed from vanadium which possesses therefore a purity higher than 99.8%. The refining method is related to the thermodynamic properties of the metal impurity system. (auth)

34868 ELECTRODEPOSITION OF CADMIUM AND ITS ALLOYS. Dambal, R. P.; Ramachar, T. L. J. Electrochem. Soc. India; 17: No. 1, 11-22(1968).

The developments in the electrodeposition of cadmium and its alloys since 1965 have been reviewed with special reference to theoretical aspects, plating baths, general techniques, properties and applications. (119 references) (Indian Sci. Abstr.)

Properties Evaluations

Refer also to abstracts 33824, 33853, 33856, 35566, 36016, and 36018.

34869 (AD-704010) CHARACTERISTICS OF ELASTICITY OF TUNGSTEN, MOLYBDENUM, NIOBIUM, AND THEIR ALLOYS AT 20 TO 2,700°C. Dreshpak, V. A. Translated from Dopov. Akad. Nauk Ukr. RSR, Ser. A; 29: 917-21(1967). 10p. (FTD-HT-23-305-69). CFSTI.

Results of experiments to determine the modulus of elasticity and rigidity of tungsten, molybdenum, niobium, and their alloys at 20 to 2700°C are presented. Ingots of the above metals and their alloys were heated to 1400 to 1600°C and deformed with 60 to 85 percent reduction. The modulus of elasticity and rigidity of specimens prepared from the ingots were determined by means of a dynamic method using a resonant frequency of the transverse and torsional vibrations. It was found that the modulus of elasticity and rigidity of tungsten, molybdenum, and tungsten-molybdenum alloys decreased with increasing temperature. The modulus of elasticity and rigidity of niobium remained practically constant to about 1400°C beyond which they began to decrease with increasing temperature. Alloying with tungsten and molybdenum increased the modulus of elasticity and rigidity of niobium alloys. (USGRDR)

34870 (BMBW-FBK-70-1, pp 81-94) MEASUREMENT OF THE THERMAL CONDUCTIVITY OF SOLIDS AT HIGH TEMPERATURES. Chafik, E.; Mayer, R.; Pruschek, R. (Stuttgart Univ. (West Germany). Institut fuer Kernenergetik). (In German).

From European Conference on Thermophysical Properties of Solids at High Temperature.

To measure the thermal conductivity of solids up to 2100°K, a non-stationary method was applied according to the theory of Cowan. The sample was heated by the light beam of a xenon arc that was modulated in a sine function. This method of energy transfer allowed not only the assay of electronic conductive and nonconductive material but also investigations in vacuum as well as noble gases. Summarized were the experimental arrangement, methods to measure the phase shift between light intensity and temperature at the backside of the sample, and experimental findings. (tr-auth)

34871 (BMBW-FBK-70-1, pp 95-124) MEASUREMENT OF THERMAL CONDUCTIVITY BY THE METHOD OF MODULATED ELECTRON BEAMS. Schmidt, H. E.; van den Berg, M.; van der Hoek, L. (European Atomic Energy Community, Karlsruhe (West Germany). European Transuranium Inst.). (In German).

From European Conference on Thermophysical Properties of Solids at High Temperature.

Thin plates of tungsten were subjected to periodically modulated electron beams. Improvement of the well-established method was achieved and the accuracy was enhanced by the determination of a correction parameter comprising radiation losses. Results agreed with previous measurements at lower temperatures and with the predictions derived from Cowan's theory. (H.B.G.)

34872 (BMBW-FBK-70-1, pp 145-75) EQUIPMENT AND TECHNIQUES FOR MEASUREMENTS OF THERMAL CONDUCTIVITY, THERMAL EXPANSION AND ASSOCIATED PROPERTIES ABOVE 1000°C. Wagner, Paul (Los Alamos Scientific Lab., N. Mex.).

Methods of measuring thermophysical properties at temperatures from 1000 to 3000°C are discussed. Equipment and methods are reviewed involving thermal expansion, thermal conductivity, electric conductivity, and emittance. Special methods for use in measuring properties of materials with anisotropic thermophysical properties are also reviewed. (J.R.D.)

34873 (BMBW-FBK-70-1, pp 429-50) RECENT THERMAL DIFFUSIVITY MEASUREMENTS OF TANTALUM-TUNGSTEN AND HAFNIUM-TANTALUM ALLOYS. Denman, Gary L. (Air Force Materials Lab., Wright-Patterson AFB, Ohio).

From European Conference on Thermophysical Properties of Solids at High Temperature.

Measurements of the thermal diffusivity of pure tantalum, three tantalum alloys, and a hafnium alloy are presented. The measurements were made using the pulse technique over the temperature range of 25 to 1300°C. The tantalum alloys are Ta-10%W, Ta-10%W-2%Hf and Ta-8%W-2.5%Hf-0.01%C and the hafnium alloy is Hf-10Ta-2Mo. Specific heats of the materials are given and used to calculate the thermal conductivity. Correlation of the electrical and thermal transport properties of the materials is presented using measured electrical resistivity results. (auth)

34874 (BMBW-FBK-70-1, pp 451-74) THERMAL CONDUCTIVITIES AND TOTAL EMITTANCES OF TANTALUM, TUNGSTEN, RHENIUM, Ta-10W, T-111, T-222, AND W-25Re IN THE TEMPERATURE RANGE 1500-2800°K. Jun, C. K.; Hoch, M. (Cincinnati Univ., Ohio).

From European Conference on Thermophysical Properties of Solids at High Temperature.

The thermal conductivities and total emittances of tantalum, tungsten, rhenium, and their alloys, Ta-10W, T_{111}, T_{222}, and W-25Re, were measured in the temperature range 1500 to 3000°K. The thermal conductivity is obtained by measuring the steady-state temperature distribution on the flat surface of a cylindrical disc heated in vacuum by induction. The total emittance is obtained by measuring the cooling curve of a sample heated in vacuum by induction when the power generation is suddenly interrupted. All sample surfaces were highly polished before the experiments. However, at the elevated temperatures the polished finish disappeared and an "equilibrium surface" was obtained. Several of the materials were obtained in arc cast and powder metallurgical forms. A difference, both in conductivity and emittance, was observed between the two types of material. A large number of tungsten samples from different sources, both arc cast and powder metallurgical, were obtained and their thermal conductivity and emittance measured. The difference between the values obtained for various tungsten materials will be discussed. (auth)

34875 (BMBW-FBK-70-1, pp 550-89) USE OF HEAT CAPACITY MEASUREMENTS TO INTERPRET ORDERING IN ALLOYS. Brooks, C. R.; Stansbury, E. E. (Tennessee Univ., Knoxville. Dept. of Chemical and Metallurgical Engineering).

From European Conference on Thermophysical Properties of Solids at High Temperature.

Heat capacities as determined by dynamic adiabatic calorimetry provide information which is useful in interpreting the type and degree of configurational ordering in alloys. Changes in atom positions occurring during the heat capacity measurements cause heat effects related to the type and degree of ordering. Thus, since the heat capacities are measured upon heating, the data which result for various initial conditions (e.g., slowly cooled or quenched) and for various heating rates give insight into configurational alterations. Heat capacities of binary solid solutions of Al, Mn, Zn, and Ga in Cu and of Pd, Cr, W, and Mo in Ni are presented for various initial conditions (e.g., quenched or slowly cooled from the highly disordered state) and for various heating rates. The data give evidence that short-range order is responsible for the anomalous heat capacity behavior observed. The heat capacities of two nickel alloys, 25 at. % Mo (Ni_4Mo) and 33 at. % Cr (Ni_2Cr), are presented and interpreted as evidence that these alloys exhibit long-range order when appropriately heat treated. (auth)

34876 (BMBW-FBK-70-1, pp 590-9) HIGH-TEMPERATURE CALORIMETRY OF METALS. Vollmer, O.; Kohlhaas, R. (Cologne Univ. (West Germany). Institut fuer Theoretische Physik). (In German).

From European Conference on Thermophysical Properties of Solids at High Temperature.

High temperature calorimeters ranging from room temperature to at least 1900°K were used to study the thermodynamic parameters of transition elements. Initial emphasis rested on the three ferro-magnetic metals, iron, cobalt, and nickel. Behavior of iron beyond the Curie temperature was determined as an important factor in alloy formation. The temperature parameters permitted predictions about the contribution of crystal structure, electrons, and magnetism. Additional measurements were performed with titanium, vanadium, manganese, copper, silver, and gold. (H.B.G.)

34877 (BMBW-FBK-70 1, pp 600-20) THERMAL EXPANSION OF PLATINUM TO 1900 K AND REFERENCE MATERIALS FOR THERMOPHYSICAL PROPERTIES. Kirby, Richard K.; Rothrock, Bruce D. (National Bureau of Standards, Washington, D. C.).

From European Conference on Thermophysical Properties of Solids at High Temperature.

The thermal expansion of two specimens of platinum has been measured using a precision optical comparator. A controlled-gradient vacuum furnace was used to heat each specimen to temperatures between 1000 and 1900°K. Within this temperature range the linear thermal expansion of the two specimens is given by $(L_T - L_{293}/L_{293}) \times 10^6 = -2685 + 8.972\ T + 2.505 \times 10^{-4}\ T^2 + 4.641 \times 10^{-7}\ T^3$. The National Bureau of Standards is actively engaged in certifying several standard reference materials for thermophysical properties. These include expansivity standards of vitreous silica, borosilicate glass, single-crystal sapphire, copper, and tungsten, and a calorimetric standard of single-crystal sapphire. (auth)

34878 (BMI-1882, Sect.D) DEVELOPMENT OF MECHANICAL-PROPERTY DESIGN DATA FOR REACTOR MATERIALS. Perrin, J. S. (Battelle Memorial Inst., Columbus, Ohio). 10p.

From Progress on Development of Materials and Technology for Advanced Reactors During January-March 1970.

Activities in a research program to obtain data on reactor component materials are summarized. Efforts devoted during the period to extending low-cycle fatigue data on Incoloy 800 to 800°F are reported. (J.R.D.)

34879 (GEMP-743) THE EFFECT OF THERMAL-MECHANICAL TREATMENTS ON THE TENSILE STRENGTH OF 19-9DL AND 12R72HV AUSTENITIC STAINLESS STEELS. Collins, C. G. (General Electric Co., Cincinnati, Ohio. Nuclear Systems Programs). Jun 1970. Contract AT(40-1)-2847. 29p. Dep. CFSTI.

Studies directed to the development of the 19-9DL and 12R72HV alloys as fuel cladding alloys for fast breeder reactors are described. The strength and ductility properties of these alloys attained with different thermal mechanical treatments were assessed by tensile tests in the 550 to 760°C temperature range and the results were used to select three basic treatments for investigation under irradiation conditions. (auth)

34880 (LA-4291-TR) THERMAL CYCLING BEHAVIOR OF URANIUM-RICH ALLOYS. Fizzotti, G.; Masperoni, A. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Trans-

lated by Ralph L. McElroy for Los Alamos Scientific Lab., N. Mex., from report RT/MET-(69)1. 14p. Dep. CFSTI.

This paper was abstracted from the original language and appears in NSA as 23: 27056. (J.R.D.)

34881 (LA-4395) FABRICATION OF NIOBIUM FLUIDIC CIRCUIT COMPONENTS BY DIFFUSION BONDING. Kirby, R. S. (Los Alamos Scientific Lab., N. Mex.). Feb 1970. Contract W-7405-eng-36. 5p. Dep. CFSTI.

A technique has been developed for fabricating fluid circuit components by diffusion bonding chemically milled niobium foil laminates. Sections of 0.002-in.-thick niobium foil were chemically milled to provide the correct channel pattern. The foil sections were then vapor coated with titanium and stacked in a diffusion bonding fixture. The laminated assembly was vacuum diffusion bonded at 1700°C by using an axial load of 300 to 500 psi, based upon the total assembly area. (auth)

34882 (RFP-1383) EFFECT OF HYDROSTATIC ROLLING CONDITIONS ON THE MALLEABILITY OF BRITTLE MATERIALS. Floyd, Dennis R. (Dow Chemical Co., Golden, Colo. Rocky Flats Div.). 12 May 1970. Contract AT(29-1)-1106. 29p. Dep. CFSTI.

The relation between stress state and malleability for sheet rolling brittle materials is examined. Improvements in the malleability of beryllium metal is achieved by altering the rolling conditions, but the effect of these conditions on stress state is unknown. A detailed analysis of the rolling process results in the following relationship between stress state, R, and the key rolling variables of friction coefficient (μ), contact length (ℓ), and thickness (t): $R = 1 - (z/e^z - 1)$, where $z = \mu\ell/t$. This theory, confirmed by tests with mild steel, shows that all three variables contribute to the same degree in changing stress state. Thus, doubling the friction coefficient or contact length has the same effect on stress state as halving the initial thickness. The curve resulting from the above relationship has a steep slope for z values under 2, where most rolling is done. Thus a large increase in stress state can be achieved by relatively minor changes in rolling conditions. (auth)

34883 HIGH-TEMPERATURE SPECIFIC HEAT OF BODY-CENTRED-CUBIC REFRACTORY METALS. Hoch, M. (Univ. of Cincinnati). High Temp. - High Pressures; 1: 531-42(1969).

High-temperature enthalpy data on chromium, niobium, tantalum, rhenium, molybdenum, and tungsten were evaluated taking into consideration higher order anharmonic contributions to the specific heat. It was found that at high temperatures ($T > \theta_T$) the enthalpy can be expressed as: $H_T - H_{298} = 3R\,[T + (\theta_D^2/20T)] - 3R\,[298 + (\theta_D^2/20 \times 298)] + bT^2 + dT^4$. This equation represents the enthalpy and its derivative, the specific heat, up to the melting point. The data indicate that the term bT^2 contains the electronic contribution to the enthalpy and that dT^4 represents the contribution of anharmonic vibrations. Previous interpretations used an equation of the type $H_T - H_{298} = r + pT + qT^2 + \Delta H_f \exp[(\Delta S_f/R) - (\Delta H_f/RT)]$, which contains five coefficients, in an attempt to explain the high-temperature variation of the specific heat by the formation of vacancies. The conclusion reached in this paper, however, is that meaningful calculations on vacancy formation can be made only when very accurate enthalpy or specific heat data are available within 10° of the melting point. (auth)(UK)

34884 ELECTRICAL AND THERMAL MASS TRANSPORT IN A MOLYBDENUM CRYSTAL AND SURFACE REARRANGEMENT OF A REFRACTORY METAL DURING DIRECTED DIFFUSION. Zakurdaev, I. V. Sov. Phys.-Solid State (Engl. Transl.); 11: 2905-13(Jun 1970).

Translated from Fiz. Tverd. Tela; 11: 3463-73(Dec 1969).

Electrical and thermal mass transport were studied in a molybdenum single crystal over the temperature range 1500 to 2500°K. The "inert-tracer" method was used to determine the rate and direction of the mass transport in the bulk metal. Surface and near-surface diffusion could be studied on the basis of the stepped structure at the surface of the metal. Noticeable mass transport begins at ~1500°K at the surface. The motion of atoms is directed toward the cathode under the influence of a direct electrical current, and toward the cold end under the influence of a temperature gradient. The activation energy for bulk self-diffusion is 4.4 ± 0.4 eV at T = 2100-2500°K. The activation energy for migration in the near-surface layer varies from 1.2 eV at 1500-1900°K to 3 eV at 2000-2200°K, and approaches the activation energy for bulk self-diffusion at high temperatures. The average atomic diffusion rate through the crystal at 2500°K and with a current density of $j = 2.3 \times 10^4$ A/cm² is 4.6 ± 0.6 μ/hr. A thermal-diffusion model for surface rearrangement of refractory metals under the influence of directional forces is discussed. (auth)

34885 CREEP OF LARGE THIN PLATES WITH CENTRAL CIRCULAR HOLES SUBJECTED TO BIAXIAL EDGE TRACTIONS. Goodall, I. W.; Chubb, E. J. (Berkeley Nuclear Labs., Gloucestershire, Eng.). Nucl. Eng. Design; 12: 89-96(May 1970).

The creep behavior in the vicinity of a circular hole in a thin plate was investigated for a time-hardening material law. The results showed how stress concentration factors varied with time for various combinations of loading and stress index. (auth)

34886 STABILITY OF SOLID INCLUSION COMPOUNDS IN MOLYBDENUM. Ageev, N. V.; Egoshina, S. G.; Model, M. S. (Inst. of Metallurgy, Moscow). Dokl. Akad. Nauk SSSR; 190: 1155-8(11 Feb 1970). (In Russian).

Inclusions, in particular carbonaceous ones, are responsible for the brittle fracture of cast molybdenum. Because of the very slight, low-temperature solubility of the included impurities in the molybdenum, they form nonequilibrium solid solutions. The stability of these solid solutions was studied by using cast molybdenum specimens with the largest crystal lattice spacing and technical grade material containing 0.014% carbon. The technical material was subjected to heat treatment to determine whether it was subject to decomposition in the presence of Ti, Zr, and Hf—followed by a more complete leaching out of the carbon from the solid solution or whether only the excess carbon was combined in an MeC type carbide, forming Mo_2C in the absence of these metals. The addition of small amounts of titanium resulted in a slight uniform increase of the microhardness, without changing the crystal spacing. Dissolution of titanium in molybdenum did not result in the decomposition of the solid solution of the impurities. It was concluded that the solid solutions with inclusions which are not decomposed by the cooling of the castings are very stable and addition of elements of the IV A group does not cause their total decomposition. (TTT)

34887 CONCENTRATION DEPENDENCE OF STAGE III RECOVERY IN COLD-WORKED MOLYBDENUM. Goedeme, G.; Stals, L.; Nihoul, J.; Pande, B. M. (SCK/CEN, Mol, Belg.). Scr. Met.; 4: 455-8(Jun 1970).

The results of a resistometric study of the concentration dependence of stage III recovery (370 to 550°K) in pure molybdenum following plastic deformation at 300°K are reported. (G.M.C.)

34888 APPLICATIONS-RELATED PHENOMENA IN ZIRCONIUM AND ITS ALLOYS. Symposium Held at Philadelphia, Pa., 5-7 November, 1968. ASTM Special Technical Publication 458. Philadelphia; American Society for Testing and Materials (1969). 396p. $27.25. (ASTM-STP-458; CONF-681105).

A total of 25 papers was presented at the meeting. A separate abstract was prepared for each of 22 papers. The remaining 3 papers have appeared previously in NSA. For abstracts of these see CONF-681105 in the Report Number Index. (G.M.C.)

For abstracts of individual papers see: 33636, 33856, 34849-34851, 34889-34897, 34910-34913, and 34927-34930.

34889 EFFECT OF TEXTURE AND STRAIN AGING ON CREEP OF ZIRCALOY-2. Fidleris, V. (Atomic Energy of Canada Ltd., Chalk River, Ont.). ASTM (Amer. Soc. Test. Mater.) Spec. Tech. Publ.; No. 458, 1-17(1969).

From Symposium on Applications-Related Phenomena in Zirconium and Its Alloys, Philadelphia, Pa. See ASTM-STP-458; CONF-681105.

Creep tests were carried out on specimens machined from heavily cold-worked Zircaloy-2 sheet material in both the rolling (longitudinal) and thickness (short-transverse) directions. The texture of the sheet was such that the majority of grains had basal-plane normals oriented 30° from the sheet-normal direction, and was independent of the metallurgical condition. The creep tests were carried out in the range 100 to 350°C on both as-received (cold-worked) and annealed material. The results varied with temperature and stress. At high stresses (all temperatures) such that rupture occurred in under 1000 hr the longitudinal specimens showed higher creep rates than the short-transverse specimens. However, at lower stresses the texture had very little effect on creep either in cold-worked material throughout the temperature range investigated, or in annnealed materials between 250 and 310°C. In annealed materials tested at temperatures below 250 and above 310°C the longitudinal specimens had higher creep rates than the short-transverse ones. The material exhibited strong dynamic strain aging which reached maximum intensity around 300°C. In some tests the creep came to a complete stop after about 1000 hr. Activation energy for creep determinations showed little variations with texture, but a very marked peaking in the strain-aging temperature range. Optical and electron microscope investigations of crept specimens revealed the formation of kink bands and a cell structure, especially in heavily deformed specimens, but little or no twinning. (auth)

34890 ANISOTROPY OF FRACTURE DUCTILITY IN FLAT TENSION-TEST BARS OF ALPHA ZIRCONIUM ALLOY. Ells, C. E.; Cheadle, B. A. (Atomic Energy of Canada Ltd., Chalk River, Ont.). ASTM (Amer. Soc. Test. Mater.) Spec. Tech. Publ.; No. 458, 68-91(1969).

From Symposium on Applications-Related Phenomena in Zirconium and Its Alloys, Philadelphia, Pa. See ASTM-STP-458; CONF-681105.

The anisotropy of fracture ductility in tension-test bars of alpha zirconium alloys was studied using Zircaloy-2, 2.5 Nb–Zr, and 2.5 Nb–0.5 Cu–Zr alloy. The use of very thick cold-rolled sheet of the first two alloys allowed a wide choice of test-bar dimensions. The ratio of strain in the width direction to strain in the thickness direction of the test bar was shown to be a complex function of crystallographic texture, specimen geometry, and hardness of the material. From these results it is now possible to understand in more detail previous observations on anisotropy of ductility reported for various zirconium alloys. (auth)

34891 MECHANICAL PROPERTIES OF ZIRCALOY-2 TUBING CONTAINING CIRCUMFERENTIALLY ALIGNED HYDRIDE. Slattery, G. F. (United Kingdom Atomic Energy Authority, Salwick, Eng.). ASTM (Amer. Soc. Test. Mater.) Spec. Tech. Publ.; No. 458, 95-110(1969).

From Symposium on Applications-Related Phenomena in Zirconium and Its Alloys, Philadelphia, Pa. See ASTM-STP-458; CONF-681105.

The effects of circumferentially aligned hydride on the transverse mechanical properties of Zircaloy-2 tubing were determined. Test variables included the method of hydriding, electrolytic versus autoclaving in LiOH solution and the method of the test, ring tension versus closed-end tube burst. The investigation showed that the strength of the Zircaloy-2 decreased by 50 percent between room temperature and 400°C. To maintain adequate ductility above 200°C in hydrided Zircaloy-2 tubing tested under biaxial stress, it was necessary to specify an upper limit in the region of 400 ppM for hydrogen content. The least ductile condition cold was with an external hydride layer present and the ductility could be significantly improved if this layer was absorbed entirely into the tube wall. Under these conditions, the critical threshold for hydrogen embrittlement could be raised from 70 to 450 ppM H_2 in the tube wall. Ring tension tests were not as sensitive to hydride embrittlement as the biaxially stressed tube-burst test. (auth)

34892 EFFECT OF ORIENTATION OF HYDRIDE PRECIPITATES ON THE FRACTURE TOUGHNESS OF COLD-ROLLED ZIRCALOY-2 AND 2.5Nb ZIRCONIUM. Aitchison, I. (Atomic Energy of Canada Ltd., Chalk River, Ont.). ASTM (Amer. Soc. Test. Mater.) Spec. Tech. Publ.; No. 458, 160-78(1969).

From Symposium on Applications-Related Phenomena in Zirconium and Its Alloys, Philadelphia, Pa. See ASTM-STP-458; CONF-681105.

The fracture toughness was estimated from single-edge notched specimens cut from three different orientations in slabs cold rolled to 20 and 40 percent reduction. In general the toughness decreased with hydrogen concentration—most rapidly in the first 100 ppM. However, specimens of 40 percent cold-rolled zirconium–niobium alloy cut so that the hydride platelets (which tend to lie parallel to the rolling plane) were parallel to the specimen plane, showed no decrease in toughness even with 500 ppM hydrogen. This is accounted for qualitatively. The fracture toughness for the Zircaloy-2 specimens was estimated both from fracture load and from crack-opening displacement. The results showed the same trend, but both methods were inaccurate here because of significant stable crack propagation. (auth)

34893 SIGNIFICANCE OF IRRADIATION-INDUCED CREEP ON REACTOR PERFORMANCE OF A ZIRCALOY-2 PRESSURE TUBE. Watkins, B.; Wood, D. S. (United Kingdom Atomic Energy Authority, Culcheth, Eng.). ASTM (Amer. Soc. Test. Mater.) Spec. Tech. Publ.; No. 458, 226-40(1969).

From Symposium on Applications-Related Phenomena in Zirconium and Its Alloys, Philadelphia, Pa. See ASTM-STP-458; CONF-681105.

Zircaloy-2 was used for pressure tubes in water reactors which operated in the temperature range 250 to 300°C. Irradiation enhanced the creep rate under these conditions to such an extent that design must be based on creep rupture. Insufficient data were available to allow a Larson-Miller extrapolation of the in-reactor creep-rupture strength, and in its place a limiting creep-strain criterion was proposed. The use of a strain limit in design of pressure tubes is discussed and both tubular and uniaxial creep-rupture data are presented. These showed that the time to reach 2 or 3 percent strain was only about half the time to failure. Irradiation creep-rupture data are presented which indicate that irradiation substantially increases the strain at which tertiary creep commences and it is suggested that irradiation increases the rupture ductility. Assuming that the in-reactor creep rate does not decrease with increase of testing time the anticipated creep strain under design conditions is of the order of 2 percent. This is well within the limit which could lead to operational restriction and the time to reach 2 percent strain is about half the time to reach failure in out-of-reactor creep-rupture tests. Thus even with this pessimistic approach there is no risk of a creep-rupture failure under design conditions. (auth)

34894 EFFECT OF TEXTURE ON THE TORSIONAL YIELDING OF ZIRCALOY TUBING. Rittenhouse, P. L. (Oak Ridge National Lab., Tenn.). ASTM (Amer. Soc. Test. Mater.) Spec. Tech. Publ.; No. 458, 241-51(1969).

From Symposium on Applications-Related Phenomena in Zirconium and Its Alloys, Philadelphia, Pa. See ASTM-STP-458; CONF-681105.

Torsion tests were performed as part of a study of the effects of texture on the biaxial plastic properties of Zircaloy tubing. The torsion yield strengths varied widely from lot to lot of tubing and, in every instance, were higher than those predicted by conventional failure theories. Variation in yield strength was ascribed to the presence or absence of texture-strengthening in the plane acted upon by the torsion stresses. Evaluation of the effect of texture was provided by comparison of torsion-yield strength ratios that were developed by modification of the maximum-shear-stress failure condition. (auth)

34895 FAILURE OF PRESSURIZED ZIRCALOY TUBES DURING THERMAL EXCURSIONS IN STEAM AND IN INERT ATMOSPHERES. Emmerich, K. M.; Juenke, E. F.; White, J. F. (General Electric Co., Cincinnati). ASTM (Amer. Soc. Test. Mater.) Spec. Tech. Publ.; No. 458, 252-68(1969).

From Symposium on Applications-Related Phenomena in Zirconium and Its Alloys, Philadelphia, Pa. See ASTM-STP-458; CONF-681105.

This work is part of a general study on the behavior of Zircaloy clad-UO_2 fuel elements during a loss-of-coolant accident to a water-cooled industrial power reactor. The fuel pins had an internal pressure due to fission gases and might or might not be exposed to steam during the thermal excursion. The energy from the nuclear heating (nuclear afterheat) plus heat from the metal–water reaction might cause the reactor core to experience rapid heat-up to about 1400°C before emergency core-cooling systems became effective in reducing the core temperatures to below the normal operating temperatures. Analysis of such an incident requires an understanding of the mode of failure and the effects of internal pressure, rate of heating, and oxidation. The temperature of failure for Zircaloy cladding material, heated in an inert atmosphere, was determined for different heating rates for tension specimens of sheet stock under constant load and for tubes with constant internal pressure. The temperature of failure (that is, 34 percent expansion for the tubes, and rupture for the tension specimens) was found to be heating-rate sensitive with higher failure temperatures occurring at higher heating rates. An analytical expression relating applied stress, the heating rate, the true strain at failure, and temperature of failure was derived through analysis of the data from these tests. The activation energy for second-stage creep in Zircaloy-4 obtained from this analysis was 78.5 kcal/mole. Pressurized tests in a steam atmosphere were made at pressures from 0.040 to 0.141 kg/mm^2 at heating rates from 0.1 to 300°C/sec. Steam oxidation caused an increase in the temperature of failure. In addition, at low heating rates and low internal pressures the mode of failure changed from ductile failure (34 percent expansion) to brittle failure (burst). High pressures and high heating rates showed failure behavior similar to that observed in an inert atmosphere. (auth)

34896 USE OF HYDROGEN GETTERS FOR PREVENTION OF HYDROGEN EMBRITTLEMENT IN ZIRCONIUM-ALLOY FUEL CANS. Spalthoff, W.; Wilhelm, H. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt, Geesthacht-Tesperhude, Ger.). ASTM (Amer. Soc. Test. Mater.) Spec. Tech. Publ.; No. 458, 338-44(1969).

From Symposium on Applications-Related Phenomena in Zirconium and Its Alloys, Philadelphia, Pa. See ASTM-STP-458; CONF-681105.

For prevention of hydrogen embrittlement in zirconium-alloy fuel cans it is proposed to insert yttrium as a hydrogen getter inside the fuel can. An evaluation of hydrogen decomposition-pressure measurements of all metal hydrides at question showed

that in the range 300 to 500°C, yttrium had the highest affinity to hydrogen. At 300°C the hydrogen in yttrium dihydride was in equilibrium with 1 ppM per weight of hydrogen solved in alpha-phase zirconium. These calculations so far were confirmed by diffusion and corrosion experiments. (auth)

34897 TENSION-TESTING VARIABLES IN ZIRCONIUM. Schemel, J. H. (AMAX Specialty Metals, Inc., Akron, N. Y.). ASTM (Amer. Soc. Test. Mater.) Spec. Tech. Publ.; No. 458, 347-59(1969).

From Symposium on Applications-Related Phenomena in Zirconium and its Alloys, Philadelphia, Pa. See ASTM-STP-458; CONF-681105.

Zirconium and its alloys were both strain-rate sensitive and at times highly anisotropic. This combination of attributes caused difficulty in properly conducting and evaluating tension-test results. Strain rate was found to affect yield strength strongly. Only in the case of the ASTM specimens was a plateau found in the yield-strength–strain-rate curve. Other specimens showed a continuing lowering of yield strength with decreasing strain rate even at very low levels of strain rate. Elongation was found to be very sensitive to both specimen shape and orientation of the specimen in the cross section. A model of typical specimen support linkage in an elevated temperature test was examined to show how cross-head displacement was related to specimen strain and the resultant variations in strain rate in constant cross-head speed tests. The results of a round robin sponsored by ASTM Committee B-10 on tension testing of tubing are presented, showing the variation among laboratories doing the testing. Attempts to explain the variation in the light of the data presented in the first part of the paper are not completely adequate but indicate necessary areas for standardization, particularly in specimen-support linkage. (auth)

34898 IMPROVEMENTS IN OR RELATING TO TREATMENT OF METALS. Cobb, Harold Ralph William; Brown, Eric (to United Kingdom Atomic Energy Authority). British Patent 1,191,273. 13 May 1970. Filed 30 Jun 1966.

Reference is made to the treatment of metals used in the manufacture of nuclear reactor fuel cans. Such fuel cans are subject to repeated flexing during reactor operation, and particularly during start-up or shut-down, and this may result in premature failure and the possible release of fission products into the coolant. The treatment method described comprises working the metal to produce a varying amount of strain hardening throughout the metal structure to give a finer grain size at the surface than in the interior. The dual grain size results in a longer plastic strain life, and the fine grain structure at the surface delays possible fractures at the metal surface, while the coarser grain size of the remaining metal increases the stress required to produce a given degree of plastic deformation. Working of a metal tube may be effected by external planetary swaging using a central mandrel, or by means of an internal swaging device. Examples are given for Nb-stabilized stainless steel. (UK)

34899 CONDENSATION OF LIQUID METALS. Rose, J. W. (Queen Mary Coll., London). Int. J. Heat Mass Transfer; 13: 749-50(Apr 1970).

Experiments on condensation of liquid metals are convenient for studying the problem of interphase matter transfer since the condensate offers only small thermal resistance. Errors arise, however, owing to the presence of non-condensing gases in the vapor. Several examples are taken to illustrate the extreme sensitivity of the experiments to very small amounts of non-condensing gases and it is stressed that caution is required when interpreting results from the viewpoint of theories of interphase matter transfer. (UK)

34900 INVESTIGATIONS OF PLASTICALLY DEFORMED COPPER SINGLE CRYSTALS IN THE STRESS-APPLIED STATE. I. A STUDY OF THE DISLOCATION BEHAVIOR IN THE SURFACE REGION AND IN THE BULK. Mughrabi, H. (Max-Planck-Institut fuer Metallforschung, Stuttgart). Phys. Status Solidi; 39: 317-27(1 May 1970).

Copper single crystals oriented for single glide were deformed in tension at 78°K to various resolved shear stresses and were then neutron-irradiated at 4 to 20°K before stress removal in order to pin the dislocations in the stress-applied state. A comparison of transmission electron micrographs obtained from the center and the surface regions shows that, from early stage II onwards, the dislocation arrangement in the surface region corresponds to a lower stress than that in the center. At the same time, the dislocation density is distinctly lower in the surface region than in the interior. Furthermore, x-ray investigations show that during deformation the primary glide plane is bent characteristically near the surface in the direction of the slip vector. Details of these results, which are in good qualitative agreement with flow stress measurements and electron microscope work of Fourie, are discussed and compared with the literature. (auth)

34901 PRISMATIC SLIP IN BERYLLIUM AND THE RELATIVE EASE OF GLIDE IN H.C.P. METALS. Regnier, P.; Dupouy, J. M. (Centre d'Etudes Nucleaires, Saclay, France). Phys. Status Solidi; 39: 79-93(1 May 1970).

The macroscopic critical resolved shear stress for prismatic slip in beryllium is found to increase with increasing temperature in the range −100 to +50°C while the microyield limit decreases regularly. Slip is initiated on the prism planes from the edge dislocations present in the annealed material. Evidences of a thermally activated locking of screw dislocations are presented. This locking is thought to occur by the usual splitting in the basal plane. The assumption that the a dislocations can also dissociate in the prismatic plane seems necessary to account for the activation of this locking. Possible dissociations in the prismatic plane are proposed; the most probable of them is $a \rightarrow a/3 + 2a/3$. It gives a ribbon of stacking fault corresponding to the transformation of two $\{10\bar{1}0\}$ hcp "flat planes" into two $\{112\}$ bcc planes. It is suggested that there is a relationship between the energy of the stacking fault on the prismatic plane and the temperature of the phase transformation hcp → bcc. This relationship permits one to account for the relative ease of slip in hcp metals. (auth)

34902 ISOTOPE EFFECT FOR SELF-DIFFUSION IN SINGLE CRYSTALS OF SILVER. Rothman, S. J.; Peterson, N. L.; Robinson, J. T. (Argonne National Lab., Ill.). Phys. Status Solidi; 39: 635-45(1 Jun 1970).

The simultaneous diffusion of ^{105}Ag and ^{110}Ag in silver single crystals was measured over the temperature range 640 to 955°C. The strength of the isotope effect has a constant value of 0.718 ± 0.011 for T < 750°C, but decreases with further increases in temperature to a value of 0.639 ± 0.013 at 937°C. This temperature dependence is significant at the 90% confidence level. Although one may explain the observed decrease by the temperature dependence of ΔK, it is considered more likely that the decrease results from the simultaneous operation of vacancy and divacancy mechanisms. At the melting point, the contribution of divacancies is from 11 to 45% of the total self-diffusivity. The diffusion coefficient of ^{110}Ag in Ag single crystals over the same temperature range was also obtained from these experiments. The least squares Arrhenius line is described by $D_0 = 0.67$ cm²/sec, Q = (45.2 ± 0.2) kcal/mol (=1.97 ± 0.1 eV). The values of D deviate systematically from this line in the manner expected for simultaneous vacancy and divacancy diffusion, although the statistical significance of these deviations is not certain. (auth)

34903 MASS SPECTROMETRIC DETERMINATION OF THE DISSOCIATION ENERGIES OF LaAu, CeAu, PrAu, AND NdAu AND PREDICTED STABILITY OF GASEOUS MONOAURIDES OF ELECTROPOSITIVE METALS. Gingerich, K. A.; Finkbeiner, H. C. (Texas A and M Univ., College Station). J. Chem. Phys.; 52: 2956-64(15 Mar 1970).

The Knudsen-cell mass spectrometric method was used to study the exchange reactions $LnAu(g) + Au(g) = Ln(g) + Au_2(g)$, where Ln stands for a lanthanide metal. For Ln = C, the third-law and second-law enthalpies ΔH_0° in kilocalories per mole were obtained as 23.4 ± 0.4 and 22.5 ± 1.2, respectively. The third-law enthalpies, in kilocalories per mole, for Ln = La, Pr, and Nd resulted in 29.6 ± 1.0, 20.3 ± 0.6, and 16.4 ± 1.5, respectively. The third-law investigation of the exchange reactions $CeAu(g) + Ln(g) = LnAu(g) + Ce(g)$ yielded the reaction enthalpies ΔH_0° in kilocalories per mole of: −3.8 ± 2.2 for Ln = La, +3.1 ± 0.8 for Ln = Pr, and +6.4 ± 1.5 for Ln = Nd. Combining the enthalpies of the first reaction with the known dissociation energy of $Au_2(g)$ and using the value obtained for D_0° (CeAu) as a standard for the second exchange reaction, the following dissociation energies, D_0°, in kilocalories per mole were derived for the gaseous lanthanide auride molecules: LaAu, 79 ± 5; CeAu, 75.0 ± 3.5; PrAu, 72.5 ± 5; and NdAu, 69 ± 6. The corresponding standard heats of formation $\Delta H_{f,298}^\circ$ in kilocalories per mole of these gaseous intermetallic compounds are 111 ± 6, 113 ± 5, 99.7 ± 5.5, and 96.5 ± 6.5, respectively. The high values for the dissociation energies of LaAu, CeAu, PrAu, and NdAu are explained in terms of the Pauling model of a single covalent bond to which a significant extra ionic contribution is added. Using this model, the dissociation energies of the diatomic alkali, alkaline earth, and rare earth aurides were calculated. The gaseous intermetallic compounds are expected to be intermediate in their ionic character to the corresponding iodides and hydrides. (auth)

34904 INVESTIGATION OF STRENGTH AND PLASTICITY OF TECHNICAL GRADE MOLYBDENUM DURING CHANGE OF LOAD. Strizhalo, V. A. Probl. Prochosti; No. 1, 82-4(Jul 1970). (In Russian).

The results of studies on the strength and plasticity of technical

grade molybdenum in isothermal conditions at 1600°C during the change of axial alternating load and low frequency of load at 1 cycle/min are described. It was established that low-cyclic fatigue breakdown has quasi-static character and is a function of the cycles on the cyclic plastic deformation. (tr-auth)

34905 MECHANICAL PROPERTIES OF NICKEL COMPOSITE REINFORCED BY TUNGSTEN FIBERS. Karpinos, D. M.; Umanskii, E. S.; Rudenko, V. N.; Tuchinskii, L. I.; Dorofeev, Yu. G. (Inst. of Problems of Science of Materials, Moscow). Probl. Prochosti; No. 1, 78-81(Jul 1970). (In Russian).

The structure of the reinforcing tungsten fibers remains unchanged during dynamic pressing. The mechanical properties of the nickel-tungsten composite incorporating tungsten fibers were studied during linear expansion at 20 to 1100°C. Hardening of the composite was compared with the hardening of pure nickel, and with increase in temperature, the coefficient of hardening was increased significantly. The stability properties of the composite are described at high temperatures. (tr-auth)

Structure and Phase Studies

Refer also to abstracts 35365 and 35547.

34906 (AD-702985) INTERMETALLIC COMPOUNDS OF YTTRIUM. Final Report, September 16, 1963-July 31, 1969. Ryba, Earle (Pennsylvania State Univ., University Park. Dept. of Materials Science). Contract DA-31-124-ARO(D)-129. 18p. (AROD-4345:5-MC). CFSTI.

Results of an investigation to determine the phase diagram for the yttrium-cadmium binary system, and to determine the intermetallic compound which occur in this system are presented. The crystal structures of these compounds were studied and compared with those of other yttrium binary compounds in an attempt to learn something about the interatomic bonding in these materials. Results are also included on the phase relations in the yttrium-cadmium-zinc alloy system. (USGRDR)

34907 GRAIN GROWTH DURING SINTERING OF W-Cu-Ni ALLOYS. Fischmeister, H.; Kannappan, A.; Lai, Ho-yi; Navara, E. (Chalmers Univ. of Tech., Goteborg). Phys. Sintering; 1: No. 1/3, G.1-13(Jul 1969).

Preliminary investigation of the mechanism for grain growth in liquid phase sintering of W-3% Cu-7% Ni and W-3% Ni-7% Cu is discussed. Data of the particle growth rate, solubility values, and activation energies indicated that volume diffusion in the liquid phase was more likely to be the rate controlling step than a surface reaction. (G.M.C.)

34908 NEW ASPECTS CONCERNING CRYSTAL-NUCLEATION IN SINTERED SOLID BODIES. Labusca, Elena (Inst. of Atomic Physics, Bucharest). Phys. Sintering; 1: No. 1/3, H.1-13(Jul 1969).

Some results are presented on the correlations between crystalline structure and the properties of sintered materials. One principal object was to obtain materials with a finer and more homogeneous structure as compared with those obtained so far. A closer investigation of the nucleation process and crystal growth was considered necessary. By a special procedure, a different type of nucleation, not mentioned so far in the literature, was induced during the first stage of the sintering process, in materials such as magnetic ferrites and pure iron and was called a nucleation of the lens-type, owing to its shape and symmetry. Another new type of nucleation found in the Ni-Fe-Mo alloys, was designated as a daisy-type of nucleation, owing to the radial disposition of numerous daisy-like nuclei round a circular one. These two new types of nucleation were very interesting as regarded the generation and evolution of the crystalline structure and the properties of solid materials. By such means, materials with very fine grains and a very advanced homogeneity of structure, were obtained, both qualities being by far superior to those obtained by conventional sintering. It is worthy to be noted that in this way, certain specific properties were considerably improved too. (auth)

34909 STRUCTURAL CHANGES IN SAMARIUM METAL AT ELEVATED TEMPERATURES. Mardon, P. G.; Koch, C. C. (Oak Ridge National Lab., Tenn.). Scr. Met.; 4: 477-83(Jun 1970).

X-ray diffraction, dilatometry, and electrical resistance observations on Sm metal indicated an allotropic transformation from the rhombohedral Sm-type structure to a hcp structure at 440 to 600°C. The phase stability was influenced by contamination (oxygen, nitrogen, or possibly silicon) and metallurgical history as seen from the transition temperature variation with specimen size and testing technique. (G.M.C.)

34910 TEXTURE CHANGES PRODUCED DURING ZIRCALOY-4 TUBING FABRICATION: FROM FORGED BILLET TO FINISHED TUBING. Hobson, D. O. (Oak Ridge National Lab., Tenn.). ASTM (Amer. Soc. Test. Mater.) Spec. Tech. Publ.; No. 458, 37-49(1969).

From Symposium on Applications-Related Phenomena in Zirconium and Its Alloys, Philadelphia, Pa. See ASTM-STP-458; CONF-681105.

Certain fabrication procedures yield tubing with large variations in texture around the circumference. Such variations lead to non-uniform mechanical properties and to difficulties in design specifications. The purpose of this work was to follow the texture changes that occur during fabrication from forged billet through extrusion, rocking, and straightening to finished tubing and to determine the effects various fabrication schedules had on the textures of the tubing. The development of texture inhomogeneities at each step of tubing fabrication was observed. The significance of this work is that, for the first time, a detailed texture study was made through an entire set of tubing-fabrication runs under controlled conditions of starting stock, tubing reductions, and heat treatment. Such an examination yielded valuable insight into the causes of varying texture quality in tubing. (auth)

34911 TEXTURE DEVELOPMENT AND TEXTURE GRADIENTS IN ZIRCALOY TUBING. Tenckhoff, E.; Rittenhouse, P. L. (Oak Ridge National Lab., Tenn.). ASTM (Amer. Soc. Test. Mater.) Spec. Tech. Publ.; No. 458, 50-67(1969).

From Symposium on Applications-Related Phenomena in Zirconium and Its Alloys, Philadelphia, Pa. See ASTM-STP-458; CONF-681105.

Basal (0002) and prism {1010} pole figures for Zircaloy-2 tubing produced by different fabrication methods were determined after extrusion and final reduction on several layers of the tube wall. For various processing conditions, markedly different textures as well as significant texture gradients across the wall thickness were found. A concentration of basal poles toward the radial direction occurred if there was a preponderance of reduction in wall thickness. This also gave a strong texture gradient across the tube wall. A split of basal poles toward the tangential direction occurred if there was a preponderance of reduction in diameter. Here, nearly no texture gradient across the tube wall appeared. Tube reducing and ball swaging developed essentially similar textures when similar reductions were accomplished. (auth)

34912 TEXTURE DEVELOPMENT AND PHASE STABILITY OF 0.5Cu-0.5Mo ZIRCONIUM DURING FABRICATION TO SHEET FORM. Kaufmann, P. D. (Wah Chang Albany Corp., Oreg.). ASTM (Amer. Soc. Test. Mater.) Spec. Tech. Publ.; No. 458, 111-25(1969).

From Symposium on Applications-Related Phenomena in Zirconium and Its Alloys, Philadelphia, Pa. See ASTM-STP-458; CONF-681105.

Texture development in the material during fabrication from 0.75-in. thick plate to 0.060-in. thick sheet is described. Anisotropic yield strength in the sheet material as a function of preferred orientation is discussed. The production, retention, and decomposition of a metastable phase is discussed, as are its effects on mechanical properties and anisotropy of the alpha zirconium. (auth)

34913 DISCUSSION ON THE EFFECTS OF MACHINE STRAIGHTENING ON HYDRIDE ORIENTATION OF ZIRCALOY-4 TUBING. Shaheen, L. C.; Rees, T. W. (Superior Tube Co., Norristown, Pa.). ASTM (Amer. Soc. Test. Mater.) Spec. Tech. Publ.; No. 458, 386-8(1969).

From Symposium on Applications-Related Phenomena in Zirconium and Its Alloys, Philadelphia, Pa. See ASTM-STP-458; CONF-681105.

It was found that straightening Zircaloy-4 reactor-grade tubing by cross-roll pressure-flex machines could cause large enough tensile hoop stresses to result in radial hydride alignment. (G.M.C.)

34914 EFFECTS OF TiC, TaC, WC, TaC-WC NbC, AND VC ON GRAIN REFINING OF PURE ALUMINUM AND ITS ALLOYS. INFLUENCES OF CARBIDES ON PROPERTIES OF ALUMINUM AND ITS ALLOYS (2ND REPORT). Nakao, Yoshinobu; Kobayashi, Toshio; Okumura, Akihiro (Kyushu Inst. of Tech., Fukuoka). Keikinzoku; 20: 163-75(Apr 1970). (In Japanese).

In order to investigate the effects of the grain refining of pure aluminum (99.99%) and its alloys (with copper, magnesium, zinc, silicon, manganese, and nickel), powdered carbides such as TiC, TaC, WC, TaC-WC, NbC, and VC were added to the former metal or alloys. Chiolite was also added as a flux to prevent the oxidation of the carbide. The molten alloys containing the carbide and chiolite were thoroughly stirred in a crucible and slowly allowed

to cool. The influences of remelting and holding of the alloys at a high temperature were investigated. The average diameters of the grains were measured in macro- and micro-structures of the specimens. Some of the specimens were investigated with x ray micro-analyzer. Powders of TiC, TaC, TaC–WC, NbC, and VC were very effective in grain refining of pure aluminum and its alloys. The effects of TiC, TaC, and TaC–WC were almost kept constant at a high temperature, and grain growth was not seen after holding at that temperature. The effects of TiC, TaC, and TaC–WC were very remarkable as compared with other carbides. The effects of NbC and VC came second, and that of WC was the least. Very effective agents for grain refining were obtained when the carbides obeyed all of the following conditions: large free energy for formation, small density, and crystal structure of NaCl type and small size factor for aluminum. (auth) (NSA of Japan)

34915 ISOTHERMAL DECOMPOSITION OF GAMMA-PHASE URANIUM–TITANIUM ALLOYS. Tomlinson, R. D.; Silcock, J. M.; Burke, J. (Univ. of Liverpool). J. Inst. Metals; 98: 154-60(May 1970).

The isothermal decomposition of the γ phase in U–Ti alloys containing 15, 20, and 25 at. % Ti was studied by single-crystal and polycrystalline x-ray methods, together with metallographic observations and microhardness measurements. A limited investigation of the process using electrical resistivity measurements was also made. The single-crystal x-ray work indicates that the 25% Ti alloy decomposes during quenching from 1475°K to room temperature into a coherent hexagonal phase closely related to U_2Ti with $[0001]_{HEX} \| [111]_\gamma$ and $[2\bar{1}\bar{1}0]_{HEX} \| [1\bar{1}0]_\gamma$. In polycrystalline specimens the continuous precipitation within the grains is accompanied by a grain-boundary-nucleated discontinuous reaction to $\alpha + U_2Ti$. Both the nucleation and growth of the discontinuous reaction are very sensitive to the matrix orientation. Matrix hardening and over ageing is attributed to the rapid formation of the hexagonal phase followed by the precipitation of α-uranium. (auth)

34916 CONSTITUTION OF MAGNESIUM–INDIUM ALLOYS CONTAINING 23 TO 100 ATOMIC PERCENT INDIUM. Pickwick, K. M.; Alexander, W. A.; Gamble, R. H. (National Research Council of Canada, Ottawa). Can. J. Chem.; 47: 3417-27(15 Sep 1969).

A constitutional diagram for magnesium–indium alloys containing between 23.2 and 100 at. % indium has been established using differential thermal analysis, electrical resistivity, and metallographic methods. An intermediate solid solution, β, with a wide range of homogeneity, is formed peritectically from the liquid and α, the magnesium primary solid solution. It extends between 23 at. % indium at 485.3°C and 86 at. % indium at 160.2°C where it is in equilibrium with γ, the indium primary solid solution. Magnesium has a limited solid solubility in indium of about 6 at. %. For alloys containing up to 50 at. % indium, the derived constitutional diagram is in good agreement with that of a previous investigation (2). Two exceptions are noted: first, there is no evidence of a long period superlattice, β'' of the CuAu II type, and second, a reaction is observed involving a transition between the two ordered phases β' and β''. For the indium-rich alloys no intermediate or ordered phase formation is observed. The results have been discussed in terms of the existing phase diagrams. (auth)

34917 CRYSTAL STRUCTURE OF A SAMARIUM–ZINC COMPOUND WITH APPROXIMATE COMPOSITION $SmZn_{11}$. Mason, J. T.; Harsha, K. S. Sree; Chiotti, P. (Ames Lab., Iowa). Acta Crystallogr., Sect. B; 26: 356-61(1970).

The crystal structure of the high temperature form of the most zinc-rich compound in the Sm–Zn system has been found to be hexagonal with lattice constants a = 8.974, c = 8.918 Å and space group P6/mmm. The structure is disordered and was found to have a stoichiometry of approximately $SmZn_{11}$. This is a new structure type in the family of structures related to the $CaZn_5$ ($D2_d$) type. The relations of this new structure to the AB_5 structure and the low temperature tetragonal form of $SmZn_{11}$ are discussed. A simple mechanism for the transformation from the hexagonal to the tetragonal form is proposed. (auth)

34918 DECOMPOSITION OF ZIRCONIUM HYDRIDE AND PRECIPITATION OF ZIRCONIUM BY ALUMINUM DIFFUSION IN Mg–Zr ALLOY. Pegoud, Joseph; Guillaumin, Jean; Millet, Pierre (Societe Industrielle de Combustible Nucleaire, Veurey, France. CEN de Saclay, Gif-sur-Yvette, France). Compt. Rend., Ser. C; 270: 1640-2(20 May 1970). (In French).

The reactions occurring in the front of the Al diffusion zone in a Mg–Zr (0.5% Zr) alloy are studied by electron microscopy and electron microdiffraction. The zirconium hydride particles out of solution are transformed and zirconium in solid solution precipitates; in both cases, the intermetallic compound $ZrAl_2$ is produced. (auth)

34919 DETERMINATION OF PHASE DIAGRAMS AT HIGH TEMPERATURE IN HIGH MELTING METAL SYSTEMS. Allibert, C.; Wicker, A.; Driole, J.; Bonnier, E. (Ecole Nationale Superieure d'Electrochimie et d'Electrometallurgie, Grenoble, France). Rev. Int. Hautes Temp. Refract.; 7: 45-50(Jan-Mar 1970). (In French).

A method based on electromagnetic separation of phases, and especially adapted to studies at high temperature is developed. The isothermal sections of the system Cu–Nb–W at 1600, 1900, and 2100°C; and the isothermal sections of the system Cu–Nb–Mo at 1900 and 2100°C are drawn up. The study of the binary system Cu–Nb is made and the results obtained by integral thermal analysis are given. (auth)

Radiation Effects

Refer also to abstracts 35955, 36033, and 36044.

34920 (AD-703617) IRRADIATION EFFECTS ON REACTOR STRUCTURAL MATERIALS. Quarterly Progress Report, November 1, 1969–January 31, 1970. Steele, L. E.; Hawthorne, J. R.; Serpan, C. Z. Jr.; Smidt, F. A. Jr.; Watson, H. E. (Naval Research Lab., Washington, D. C.). 15 Sep 1970. 51p. (NRL-MR-2088). CFSTI.

Research for the period November 1st 1969 to January 1st 1970 is reported. Improved radiation embrittlement resistance in commercial scale melt of Type A533-B pressure vessel steel was demonstrated. An outline of the effects of fast reactor environment on selected structural and cladding alloys is given. The dynamic tear, Charpy-V, and drop-weight results from irradiation in a power reactor were correlated. Neutron exposure of Army SM-1 reactor vessel and related embrittlement projections were described. Initial results of examining radiation sensitive steels by transmission electron microscopy were given. The newly developed automated system for fatigue crack propagation studies on irradiated metals is described. (auth) (USGRDR)

34921 (BMI-1882, Sect.B) CLADDING, STRUCTURAL, AND COMPONENT MATERIAL STUDIES. (Battelle Memorial Inst., Columbus, Ohio). 14p.

From Progress on Development of Materials and Technology for Advanced Reactors During January–March 1970.

Research and development results are summarized on determining the mechanical properties of irradiated cladding materials, energy spectral effects in neutron radiation effects on cladding, irradiation-induced embrittlement, and evaluation of ferritic steel. (J.R.D.)

34922 (BNWL-1349-1, pp 4.1-97) IRRADIATION DAMAGE TO REACTOR METALS. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

From Reactor Fuels and Materials Development Programs for Fuels and Materials Branch.

Research and development results are presented on radiation effects on reactor metals, radiation effects on heavy section pressure vessel steel, testing of cladding, mechanical properties of stainless steels, and welding methods and materials. (J.R.D.)

34923 (BNWL-1349-1, pp 5.1-33) FAST REACTOR DOSIMETRY AND DAMAGE ANALYSIS. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

From Reactor Fuels and Materials Development Programs for Fuels and Materials Branch.

Research and development efforts are described on damage function, EBR-II core spectra corrections, reactor materials dosimetry, computer simulation of radiation damage, computer analysis of Dounreay core flux, computer simulation of dislocations in crystal structures, and fluence determination using time-varying flux. (J.R.D.)

34924 (ORNL-4557) EVALUATION OF THORIUM–URANIUM ALLOYS FOR THE UNCLAD-METAL BREEDER REACTOR. Copeland, G. L. (Oak Ridge National Lab., Tenn.). Jun 1970. Contract W-7405-eng-26. 74p. Dep. CFSTI.

The literature on thorium-uranium alloys was surveyed for information relative to the use of a Th–20% U alloy for the fuel element for the Unclad-Metal Breeder Reactor. The applicable physical, fabrication, and irradiation properties for a range of thorium-uranium alloy compositions are summarized. Several methods are available for manufacturing the fuel element, but

the feasibility of most of the proposed methods has not been demonstrated for this alloy. Limited data indicated that the alloy will have the irradiation stability to reach the design life of 33,000 MWd/metric ton at ≤650°C. The distribution of the phases in the alloy was determined by the fabrication technique and will influence the properties of the fuel element. Compatibility of the fuel with the sodium coolant was not considered for this report. (auth)

34925 (WANL-TME-1922) TENSILE PROPERTIES OF IRRADIATED INCONEL 718 AND INCONEL X750 AT CRYOGENIC TEMPERATURES. Shogan, R. P. (Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.). Aug 1969. 38p. Dep. CFSTI.

Inconel 718 and Inconel X750 parent and welded sheet and Inconel 718 brazed sheet were irradiated in GTR-19 (WANL Irradiation Test 37/W405) and tested at temperatures from 140 to 2000°R. Inconel 718 sheet exhibited reductions in elongation at 140 and 1500°R while welded sheet and brazed specimens showed no change in properties after the irradiation. The ultimate tensile strength was not affected but the yield and notched tensile strengths of Inconel X750 parent and welded specimens increased at 140 and 540°R. These effects were removed after a one hour anneal at 1000°R. The elongation of the Inconel X750 sheet decreased at 140°R and at the elevated test temperatures. (auth)

34926 ENERGY DEPENDENCE OF THE RANGE OF H_1^+ IONS AND DEPTH DISTRIBUTION OF INTERSTITIAL HYDROGEN IN A NICKEL FILM. Katrich, N. P. This paper was summarized in At. Energ. (USSR); 26: 286-7(Mar 1969) as paper No. 272. (In Russian).

Results of the experiments show that the retarding power of Ni films for H^+ ions in the energy range 14 to 42 keV is not proportional to the velocity of the ions. The retardation is not wholly due to polarization losses associated with free electrons in the metal. (J.R.D.)

34927 IN-REACTOR CREEP OF ZIRCONIUM-ALLOY TUBES AND ITS CORRELATION WITH UNIAXIAL DATA. Ibrahim, E. F. (Atomic Energy of Canada Ltd., Chalk River, Ont.). ASTM (Amer. Soc. Test. Mater.) Spec. Tech. Publ.; No. 458, 18-36(1969).

From Symposium on Applications-Related Phenomena in Zirconium and Its Alloys, Philadelphia, Pa. See ASTM-STP-458; CONF-681105.

A creep experiment on 23-mm diameter tubular specimens of Zircaloy-2 is described. The specimens were stressed biaxially at hoop stresses from 11 to 26 kgf/mm² at 260°C at three neutron flux conditions. The results confirmed that fast neutrons increased creep rates at all the stresses tested, but thermal neutrons had no detectable effect. The creep data were consistent with those obtained on larger tubes. A method is described for correlating biaxial tubular and uniaxial in-reactor creep results for zirconium alloys and this is applied to cold-worked Zircaloy-2, cold-worked 2.5 Nb-Zr, and heat-treated 2.5 Nb-Zr alloys. (auth)

34928 EMBRITTLEMENT OF ZIRCALOY-2 PRESSURE TUBES. Watkins, B.; Cowan, A.; Parry, G. W.; Pickles, B. W. (United Kingdom Atomic Energy Authority, Culcheth, Eng.). ASTM (Amer. Soc. Test. Mater.) Spec. Tech. Publ.; No. 458, 141-59(1969).

From Symposium on Applications-Related Phenomena in Zirconium and Its Alloys, Philadelphia, Pa. See ASTM-STP-458; CONF-681105.

Previous work on hydrogen absorption was extended to cover the effect of radial hydrides and greater hydrogen concentrations, and the effect of neutron irradiation on Zircaloy-2 pressure tubes. Specimens with radial hydrides were produced by modification of tube-manufacturing route and by hydriding under pressure in lithiated water. Both series of tests showed that the effect of the hydrides was marked at 20°C but was small at 300°C. Thus, at design condition, the critical crack length was of the order of 3 to 4 in. Critical crack-length tests on irradiated tubes show that, up to doses of 10^{21} n/cm² (>1 MeV), there was no decrease in critical crack length on irradiation. Results from small specimens and tube behavior were correlated. This permitted assessing the effect of a large number of material variables (for example, H_2 content, hydride orientation, neutron dose, etc.). For example, the effect of irradiation up to doses of 2×10^{21} n/cm² was assessed on the basis of both tension and notched specimens. These showed that the effect on impact specimens saturated at 10^{20} n/cm² but there was a progressive but small increase in tensile strength over the range of neutron dose examined. This work showed that the critical crack length of through-thickness defects under reactor-design conditions was of the order of 3 to 4 in. Leakage could be expected to occur when the through-thickness crack was of the order of 0.5 in. and failure due to instability was not, therefore, considered feasible. (auth)

34929 EFFECT OF NEUTRON IRRADIATION AND COLD WORK ON THE STRAIN-AGING BEHAVIOR OF ZIRCALOY-2. Veevers, K.; Rotsey, W. B.; Snowden, K. U. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). ASTM (Amer. Soc. Test. Mater.) Spec. Tech. Publ.; No. 458, 194-209(1969).

From Symposium on Applications-Related Phenomena in Zirconium and Its Alloys, Philadelphia, Pa. See ASTM-STP-458; CONF-681105.

The strain-aging behavior of annealed Zircaloy-2 in vacuum was studied as a function of deformation temperature, integrated fast-neutron dose, and degree of cold work. Strain aging occurred in the temperature range 200 to 500°C. Transmission electron microscopy showed that in the temperature range 300 to 450°C, dislocations were arranged in a cell structure, and that at 500°C two-dimensional hexagonal dislocation nets were present. Between 200 and 400°C, the strain aging was found to be due to the presence of oxygen; however, the origin of the strain aging between 400 and 500°C was not identified. At 300°C the strain aging decreased with increasing neutron dose and increasing amounts of prior cold work. Post-irradiation annealing experiments between 400 and 600°C increased the yield stress of the material at 300°C after irradiation at 325°C. (auth)

34930 EFFECTS OF NUCLEAR RADIATION ON THE CORROSION, HYDRIDING, AND OXIDE PROPERTIES OF SIX ZIRCONIUM ALLOYS. Johnson, A. B. Jr. (Battelle Memorial Inst., Richland, Wash.). Contract AT(45-1)-1830. ASTM (Amer. Soc. Test. Mater.) Spec. Tech. Publ.; No. 458, 301-24(1969).

From Symposium on Applications-Related Phenomena in Zirconium and Its Alloys, Philadelphia, Pa. See ASTM-STP-458; CONF-681105.

A series of in-reactor corrosion tests were conducted in the G-7 loop of the Engineering Test Reactor (ETR) in pH 10 NH_4OH at 270 to 280°C. Six zirconium alloys were exposed in as-etched and prefilmed (400°C steam) surface conditions. The six alloys were Zircaloy-2, Zircaloy-4, Zr-3Nb-1Sn, Zr-2.5Nb, Zr-1.2Cu-0.28Fe, and Zr-1.2Cr-0.08Fe. Exposures were 25 to 174 days in high-flux, low-flux, out-of-flux, and out-of-reactor environments. Results from the 174-day exposure are emphasized, but corrosion and hydriding data from the complete test series are compared. A marked upturn in corrosion rate between the 77- and 174-day exposures was attributed to an increase in oxygen level near the end of a deoxygenating resin life. In the 174-day experiment, corrosion rates were accelerated on the six alloys at the high-flux position, but only on Zr-Cr-Fe specimens at the low-flux position. Prefilming adversely affected the corrosion of Zr-Cr-Fe, Zr-Cu-Fe, Zircaloy-2, and Zircaloy-4 specimens. The alloys containing niobium were the most resistant to in-flux corrosion and hydriding. Hydrogen-absorption rates were generally proportional to corrosion rates. Monoclinic zirconium oxide was the principal phase on high-fluence (1.7×10^{21}, n/cm², >1 MeV) specimens of the six alloys. Non-uniform oxidation was observed on Zr-Cr-Fe and Zr-2.5Nb alloys, including pustules, pitting, and cracks. Banded chromium segregation was observed in a Zr-Cr-Fe oxide and nodular copper segregation was observed in a Zr-Cu-Fe oxide; niobium distribution was relatively uniform in a Zr-2.5Nb specimen. (auth)

Ceramics and Cermets

Refer also to abstracts 33831, 34837-34841, 34870, and 34872.

Preparation and Fabrication

Refer also to abstracts 33758 and 33760.

34931 (Y-1720) COKING URANIUM-LOADED ION EXCHANGE MATERIALS. Schmitt, C. R. (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). 28 May 1970. Contract W-7405-eng-26. 26p. Dep. CFSTI.

Uranyl compounds were adsorbed on cation and anion exchange resin spheres and cellulose materials to provide a wide range of uranium-to-resin loadings. The uranium-loaded resins and celluloses were carbonized at 950°C and high fired at 1,400, 1,700, and 2,200°C in an inert atmosphere. Chemical analyses were obtained and x-ray diffraction studies made to identify the chemical compounds of the uranium that were associated with the carbon or graphite matrix. (auth)

34932 SIMPLE APPARATUS FOR THE PREPARATION OF THIN FILMS BY COEVAPORATION. Wood, C.; Jones, T. H. (Northern Illinois Univ., DeKalb). Rev. Sci. Instrum.; 41: 874-5(Jun 1970).

A simple apparatus, designed and constructed for the preparation of thin films by coevaporation in a vacuum, is described. This apparatus has been used to prepare single crystals of rare earth chalcogenides by epitaxial techniques, but could be used for the preparation of single crystal thin films of many elements or compounds. (auth)

34933 SOME PRESSING, KINETIC, AND STRUCTURAL PARAMETERS OF URANIUM DIOXIDE POWDERS SINTERED IN INERT AND REDUCING ATMOSPHERES. Majani, C. (CNEN, Rome); Ferro, C.; Francia, M.; Stamenkovic, I. Phys. Sintering; 1: No. 1/3, M.1-23(Jul 1969).

The first series of results obtained during the study of the UO_2-powder pressing and sintering are discussed. The cold pressing of ceramic grade UO_2 powder was analyzed by means of a new, although only qualitative, phenomenological approach by introducing the powder fragility parameter. The first stage kinetics of the UO_2 powder sintering were studied from dilatometric and microstructural investigations using reducing and inert atmospheres. The results help to explain, at least qualitatively, the mechanism of uranium dioxide powder sintering, by means of a new, more realistic approach. (auth)

34934 SINTERING OF TITANIUM DIOXIDE WITH DIFFERENT OXIDES ADDITIVES. Zagar, Ludwig (Technische Hochschule, Aachen). Phys. Sintering; 1: No. 1/3, R.1-16(Jul 1969).

The sintering behavior of pressed mixtures of TiO_2 and O to 10 mole % of Al_2O_3, ZrO_2, MgO, CaO, or ZnO was investigated with a Lutz high-temperature microscope. The sintering temperature of TiO_2 increased with the addition of Al_2O_3 and lowered in the presence of small quantities of the other oxides. Additions of low concentration of the oxides increased both the sintering degree and rate of TiO_2 but large oxide concentrations lowered the sintering degree and rate. An exception was ZnO which increased the sintering rate of TiO_2 at all concentrations. (G.M.C.)

34935 CRYSTAL GROWTH OF VANADIUM DIOXIDE. Kimizuka, Noboru; Saeki, Masanobu; Nakahira, Mitsuoki (National Inst. for Researches in Inorganic Materials, Tokyo). Mater. Res. Bull.; 5: 403-8(Jun 1970).

The phase diagram of the V–O system at 1500°K was reexamined (mainly in the VO_2 region) and vanadium dioxide crystals were grown from vanadium pentoxide (mp about 950°K) under various oxygen partial pressures. The total pressure was one atm. The chemical analyses of these oxides indicated the stability range of VO_{2+x} from x = 0.00 to x = 0.07 with corresponding oxygen partial pressures from $10^{-4.1}$ to $10^{-2.9}$ atm. Electrical resistance measurements on these crystals documented the phase changes. (auth)

34936 PROCESS FOR THE PRODUCTION OF SPHERICAL OXIDIC OR CARBIDIC PARTICLES, ESPECIALLY NUCLEAR FUEL PARTICLES. (to Nuklear-Chemie und Metallurgie Gesellschaft). British Patent 1,193,491. 3 Jun 1970. Priority date 6 Jul 1966, Germany.

High-density spherical oxide or carbide particles were produced directly from metal salt solutions. The metal salt solution was emulsified with oil in the presence of an emulsifier to form an emulsion with extremely fine particle size. A binder was then added to the emulsion which was added dropwise to an alkaline precipitation bath with the result that the drops solidified to form solid particles. The particles were dried and sintered. Examples are given for the production of UO_2, UO_2–ThO_2, UC_2–ThC_2, and ZrO_2 particles. (G.M.C.)

34937 CONVERSION PROCESS OF UF_6 TO UO_2 IN ASSOCIATION WITH THE FUEL CYCLE IN JAPAN. Hirose, Jiro (Sumitomo Metal Mining Co. Ltd., Tokyo); Kotoku, Takeshi. Genshiryoku Kogyo; 16: 15-18(Jan 1970). (In Japanese).

In establishing sound fuel cycle in Japan, the fabrication of UO_2 pellets for light-water reactors is important, and a problem is the conversion of UF_6 to UO_2. Plants are being built for this purpose for operation from 1971. The capacity of each is 240 tons of UO_2 per year. The capacity is increased so as to meet the nation's requirement. The conversion of UF_6 to UO_2 is described below. The over-all procedure, starting from UF_6 to the production of UO_2, and the requirements of high purity, high yield, criticality control, and safety are reviewed. The conversion process is the ADU (ammonium diuranate) method. The product is high-purity powder, adaptable to various specifications. Another conversion process is by solvent extraction. High-purity UO_2 powder without F content, suitable for superior sintering, is obtained by high yield inexpensively. The relation of fuel demand and the capacity of conversion is discussed. (NSA of Japan)

34938 GROWTH OF VANADIUM PENTOXIDE SINGLE CRYSTALS AND THEIR DISLOCATION STRUCTURE. Abdullaev, A. A.; Belyaev, L. M.; Binarov, I. V.; Dobrzhanskii, G. F.; Yankelevich, R. G. (Inst. of Crystallography, Moscow. Inst. of General and Inorganic Chemistry, Kiev). Sov. Phys.-Cryst. (Engl. Transl.); 14: 957-9(May-Jun 1970).

Translated from Kristallografiya; 14: 1095-7(Nov-Dec 1969).

After purification to 99.99% purity, V_2O_5 single crystals weighing >200 g were grown by a zone-melting technique using a quartz boat and O_2 medium. Chemical etching figures on the (010) and (100) planes were used to study the dislocation structure. The dislocation density was found to be $\sim 10^7$ cm^{-2} for all growth conditions. (D.L.C.)

34939 THERMODYNAMIC CONSIDERATIONS RELATING TO THE USE OF ELECTROCHEMICAL TECHNIQUES FOR THE GROWTH OF SINGLE CRYSTALS OF BORIDES. Huggins, Robert A. (Advanced Research Projects Agency, Washington, D. C.). Mater. Res. Bull.; 5: 391-401(Jun 1970).

Thermodynamic aspects of the formation of borides from fused salt solvents by isothermal electrolysis in a simple model system are discussed. Particular attention is given to factors which influence the composition and defect structure of the product formed. (auth)

34940 SYNTHESIS AND X-RAY STUDY OF SINGLE-CRYSTAL $3Al_2O_3$.BeO. Harris, L. A.; Yakel, H. L. (Oak Ridge National Lab., Tenn.). J. Amer. Ceram. Soc.; 53: 359(Jun 1970).

Single crystals of $3Al_2O_3 \cdot BeO$ were synthesized. X-ray diffraction data were obtained for the crystals from rotation, Weissenberg, and precession films. (G.M.C.)

34941 INERT DIMENSIONALLY STABLE MICROSPHERES FOR COATED-PARTICLE IRRADIA TION TESTING. Pollock, C. B.; Beatty, R. L.; Scott, J. L. (Oak Ridge National Lab., Tenn.). J. Amer. Ceram. Soc.; 53: 358(Jun 1970).

The development of spherical test particles for irradiation testing is described. Sulfonated styrene divinylbenzene copolymer resins of spherical geometry with 1 to 15% crosslinking were carbonized in fluidized beds. Silicon carbide microspheres were produced by deposition of SiC on the carbon microspheres and the microspheres were then coated with pyrolytic carbon. (G.M.C.)

34942 STUDIES IN TANTALUM OXIDE CRYSTAL GROWTH. Wolten, G. M.; Chase, A. B. (Aerospace Corp., El Segundo, Calif.). J. Solid State Chem.; 2: 24-6(Jun 1970).

Crystals of β-Ta_2O_5 and γ-Nb_2O_5 were grown from molten KPO_3 and mixtures of KPO_3 and KVO_3. A search for additional polymorphs of β-Ta_2O_5 in this system has instead revealed five nothitherto-reported tantalum compounds containing potassium or phosphorus or both and, in one case, vanadium. (auth)

Properties Evaluations

Refer also to abstract 33843.

34943 (AD-701394) THERMODYNAMIC PROPERTIES OF TERNARY REFRACTORY CARBIDES. III. ZIRCONIUM–HAFNIUM–CARBON. Technical Report, July 1, 1967–June 30, 1969. Hoch, M.; Yamauchi, S. (Cincinnati Univ., Ohio). Contract F33615-67-C-1565. 29p. (AFML-TR-69-209(Pt.3)). CFSTI.

The thermodynamic properties of ternary zirconium–hafnium carbide, Zr (x)Hf (1-x)C (y), having the sodium-chloride type structure were studied, using the time-of-flight mass spectrometer. The ratios of the activities of the components were measured as a function of composition at 2440°K. From the variation of the ratio of activities with composition, the pairwise interaction energies were obtained. The metal–metal interaction energy (E (12) – (E (11) + E (22))/2) = 1.9 plus or minus 0.3 kcal/mole, similar to that in the body-centered cubic zirconium–hafnium metallic system. The difference between the zirconium–carbon and hafnium–carbon interaction energy E (13) – E (23) is a function of composition and can be expressed as: E (13) – E (23) = (9.8 plus or minus 0.05) – (7.5 plus or minus 0.2)x in kcal/mole. (auth) (USGRDR)

34944 (BMBW-FBK-70-1, pp 136-44b) MEASUREMENT OF THE THERMAL CONDUCTIVITY OF CERMETS WITH THE RADIAL FLUX METHOD. Schulz, B.; Thuemmler, F.; Ondracek, G. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material und Festkoerperforschung). (In German).

From European Conference on Thermophysical Properties of Solids at High Temperature.

The cermet system La_2O_3–W was studied. The samples were prepared under pressure and sinter temperatures up to 1750°C. Higher temperatures could not be employed because of the decomposition of lanthanum oxide; therefore, the samples contained pores. Heating of the samples was accomplished by an electric current sent through a tungsten wire isolated from the probe by a surrounding tube of aluminum oxide. Method and results are presented graphically. Variability of results up to 50% is primarily associated with the composition of the cermet and not with the measuring technique. (H.B.G.)

34945 (BMBW-FBK-70-1, pp 309-19) ELECTRONIC WORK FUNCTIONS IN THE SYSTEM Zr-O IN RELATION TO THE OXYGEN CONCENTRATION. Nagel, H.; Mayer, R.; Goretzki, H. (Max-Planck-Institut fuer Metallforschung, Stuttgart (West Germany). Stuttgart Univ. (West Germany)). (In German).

From European Conference on Thermophysical Properties of Solids at High Temperature.

For both space and reactor problems the direct conversion of heat into electric energy is important. One of the most decisive factors for efficiency conversion systems is the selection of proper materials for electrodes. Mixed crystal phases between zirconium and oxygen produced by sintering under pressure are investigated. The Schottky–Richardson method is used to determine the emission energy of electrons at 1600 to 1850°C. The experimental data show a strong dependency of the energy on the oxygen concentration. This effect is explained by the elevation of Fermi's energy of free electrons in metallic solids. By increasing the oxygen content, the concentrations of electrons in the conduction band also are enhanced. The findings agree with theoretical concepts. (tr-auth)

34946 (BMBW-FBK-70-1, pp 411-19) MEASUREMENTS OF THERMAL DIFFUSIVITY IN MIXTURES OF THE OXIDES OF URANIUM AND THORIUM. Ferro, C.; Moretti, S.; Patimo, C. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). (In French).

From European Conference on Thermophysical Properties of Solids at High Temperature.

A method was developed to determine the thermoconductivity of UO_2 and mixtures of UO_2 with ThO_2. The principle consisted of a small volume heated by tungsten resistors capable of 2200°C, a laser beam of 15 joules, and a precision optical thermometer. Uranium dioxide was sintered under pressurized hydrogen atmosphere. The obtained experimental values are presented graphically. The pelletized dioxide mixtures of thorium and uranium were obtained by compression of the powder and sintering at 1700°C under hydrogen atmosphere. Results are presented by graphs, x-ray defraction diagrams, and microphotographs of crystalline structures. (H.B.G.)

34947 (BMBW-FBK-70-1, pp 631-41) THERMAL EXPANSION OF CERMETS. Nazare, S.; Ondracek, G. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material und Festkoerperforschung).

From European Conference on Thermophysical Properties of Solids at High Temperature.

Aspects of component quantitive distribution in cermets as it affects thermal expansion and deformation in cermet shapes are discussed. A review of present knowledge is presented and it is noted that while progress is being made, exact experimental data on all involved parameters are required before a derived equation can be proved valid. (J.R.D.)

34948 (LA-4417) CMF-13 RESEARCH ON CARBON AND GRAPHITE. Report No. 12. Summary of Progress, November 1, 1969–January 31, 1970. Smith, Morton C. (Los Alamos Scientific Lab., N. Mex.). 8 Apr 1970. Contract W-7405-eng-36. 27p. Dep. CFSTI.

Research on carbon and grapnite is reported for the effects of heat treatment on crystalline parameters of Santa Maria coke, characterization of the products of ground heat-treated Santa Maria coke, the production and properties of hot-molded Santa Maria graphite, extruded resin-bonded graphites, extruded anisotropic and fiber-reinforced molded graphites, elastic properties of Poco graphites, production of carbon foam, and the measurement of the lattice parameters of boronated graphites. (J.C.W.)

34949 STRESS RELAXATION BEHAVIOUR OF ZIRCONIUM–2.5 AT. PERCENT OXYGEN ALLOY. Das Gupta, P. (Bhabha Atomic Research Centre, Trombay, India). Trans. Indian Inst. Metals; 22: No. 3, 5-8(Sep 1969).

Influence of temperature, strain rate, and plastic strain on the stress relaxation characteristics of zirconium–2.5 at.% oxygen was studied. The relaxation rate parameter was strongly dependent upon temperature and almost independent of strain rate and initial plastic strain. The values of activation volume calculated from relaxation measurements exhibited a strong temperature dependence, particularly in the high temperature range. The results were discussed on the basis of free loop lengths of dislocations available for deformation. (auth)

34950 DENSIFICATION PROCEDURES DURING URANIUM DIOXIDE SINTERING. Bacmann, J. J.; Cizeron, G.; Delmas, R. (CEN de Saclay, Gif-sur-Yvette, France. CEN, Grenoble, France). Mem. Sci. Rev. Met.; 67: 123-36(Feb 1970). (In French).

From Autumn Meeting of the French Society of Metallurgy, Paris, France.

Dilatometric tests were performed on pellets prepared from two types of powders of uranium dioxide, at temperatures between 600 and 1400°C. The UO_2 behavior around stoichiometry was investigated in dry hydrogen atmosphere or in hydrogen atmosphere containing 2 vol % water vapor. The tests made on the hyperstoichiometric dioxide ($UO_{2.25}$; $UO_{2.27}$; $UO_{2.16}$; $UO_{2.25}$; $UO_{2.3}$) were made in a confined helium atmosphere. For both stoichiometric and hyperstoichiometric UO_2, the activation energies are constant (90 and 65 kcal/mole) as long as the pellet density is lower than 93% of theoretical value but are found to increase beyond this limit (>110 kcal/mole and ≈85 kcal/mole). A micrographic study reveals an open and intergranular porosity for the samples having density below 93≈ of theoretical value and a closed and intergranular porosity beyond this limit. Intergranular diffusion of U is found to be preponderant in sintering kinetics as long as the pellet porosity is open and intergranular; the volume diffusion is preponderant when the pores are isolated in the grains. (auth) (France)

34951 LEAD CONTENT OF GLASS USED FOR SHIELDING TELEVISION RECEIVER COMPONENTS AND ITS RELATION TO EXPOSURE RATE. Levine, Harry; Ruggera, Paul S. (Bureau of Radiological Health, Rockville, Md.). Radiol. Health Data Rep.; 11: 135-6(Mar 1970).

The effect of the lead composition of glass used in components of television equipment on the transmission of x radiation from the equipment was studied and tested. It was found that for thin glass tube envelopes, increasing the lead content from 30.3% to 50.1% reduced the x-ray exposure rate by a factor of 40. It is concluded that a simple field test for determining the lead content of glass tubes in television sets could be used to identify the faulty components which emit x radiation. (L.C.L.)

34952 EFFECTIVENESS OF BORON-LOADED ADDITIVES IN SHIELDING AGAINST SCATTERED ACCELERATOR RADIATION. Zaitsev, L. N.; Kimel, L. R.; Komochkov, M. M.; Sidorin, V. P.; Sychev, B. S.; Ulitin, O. A. This paper was summarized in At. Energ. (USSR); 26: 286(Mar 1969) as paper No. 271. (In Russian).

Results of investigations of boron additives to ordinary concrete for shielding reveal that a decrease in the required shield thickness is effected but not enough to justify its added cost. For this reason, boron-loaded concrete should be considered for shielding from scattered radiation only when there are strict limitations on the dimensions of the shielding. (J.R.D.)

34953 MEASUREMENT OF THE HARDNESS OF GRAPHITE AT HIGH TEMPERATURE. Kamoun, G. High Temp. - High Pressures; 1: 597-600(1969). (In French).

The Shore hardness of three types of graphite was measured from room temperature up to ~3000°C on Joule-heated specimens. The apparatus incorporates a ball-tipped tube which is released and recaptured after rebound by electromagnets, and electronically timed, the rebound time being related to rebound height. (auth) (UK)

34954 HOT HARDNESS, THERMAL DIFFUSIVITY, AND ELECTRICAL RESISTIVITY OF URANIUM OXYCARBIDES. Henry, Jack L. (Bureau of Mines, Albany, Oreg.); Blickensderfer, Robert; Paulson, Danton; Bates, J. Lambert. J. Amer. Ceram. Soc.; 53: 335-9(Jun 1970).

Several predominantly single-phase uranium oxycarbide compositions were examined to determine the effect of oxygen content on the hot hardness, thermal diffusivity, thermal conductivity, and electrical resistivity. Little difference was noted in hot hardness over the low-temperature range; however, increased oxygen content appeared to reduce the hardness above 700°C. Thermal diffusivity and thermal conductivity were reduced by increased oxygen content. This decrease was most pronounced at lower temperatures, and the temperature dependence varied significantly with oxygen content. The thermal diffusivity of oxycarbides having small percentages of oxygen decreased with increasing temperature, whereas that of oxycarbides with greater oxygen content increased very slightly. The thermal conductivity data were in fair agreement with those reported for the monocarbide. Electrical resistivity was increased by increased oxygen content and showed a

positive temperature dependence. The data indicated that electronic conductivity at 1500°C accounted for approximately 85% of the total thermal conduction at the 2 at. % oxygen level and approximately 95% of the total at the 16 at. % oxygen level. (auth)

34955 THERMAL-STRESS CRACK-INITIATION METHOD FOR RANKING CERAMIC MATERIALS. Carden, A. E. (Univ. of Alabama, University); Andrae, R. W. J. Amer. Ceram. Soc.; 53: 339-42(Jun 1970).

A test is described which permitted ranking of brittle materials according to their resistance to thermal fracture under steady-state conditions. A water-cooled probe and a small, thin, annular disk specimen heated by a radiator were used. Tests on AUC graphite and on a series of composites of transition-metal pseudo-binary solid-solution carbides with graphite were very reproducible and reliable. A thermal-stress analysis for the graphite agreed well with the test results. (auth)

34956 THERMAL EXPANSION AND ORTHORHOMBIC-TETRAGONAL TRANSITION OF THE TUNGSTEN TRIOXIDE PHASE. Ackermann, R. J. (Argonne National Lab., Ill.); Sorrell, Charles A. High Temp. Sci.; 2: 119-30(Jun 1970).

The thermal expansion and the orthorhombic-tetragonal transition of tungsten trioxide were studied from 25 to 950°C by means of a high temperature x-ray diffractometer. Extensive anisotropic expansion of the orthorhombic phase was observed prior to and during the transition from 650 to 750°C. The transition was definitely greater than first order and was discontinuous in the x and y directions, but, apparently, continuous in the z direction. Units of both phases coexist over the range of temperature 710 to 770°C and reproducible hysteresis behavior was observed between the heating and cooling curves. The conversion of orthorhombic to tetragonal units occurred with a decrease in specific volume, which implied that the higher temperature tetragonal structure possessed a greater degree of staggering of tungsten atoms above and below the xy plane than in the lower temperature orthorhombic form. The results are examined in terms of the description of hybrid crystals and associated hysteresis phenomena. (auth)

34957 EFFECT OF OXYGEN PRESSURE ON THE BEHAVIOR OF THE SYSTEM Cr_2O_3-La_2O_3. Berjoan, Rene; Coutures, Jean-Pierre; Foex, Marc (CNRS, Montlouis, France). Compt. Rend., Ser. C; 270: 1654-7(20 May 1970). (In French).

The systems containing chromium oxide III and lanthanum oxide are found to absorb in the liquid state a notable amount of oxygen which is removed in a great measure during their solidification. The effect of this phenomenon on the solidification curves is studied by thermal analysis. (auth)

Structure and Phase Studies

34958 (LA-4157-TR) THE UC-ZrC-C SYSTEM. Inanc, Oezel (Kernforschungsanlage, Juelich (West Germany). Institut fuer Reaktorwerkstoffe). Translated for Los Alamos Scientific Lab., N. Mex., from report JUL-516-RW. 46p. Dep. CFSTI.

The report was abstracted from the original language and appeared as NSA 22: 4114. (J.R.D.)

34959 SYSTEM HfO_2-Er_2O_3. Spiridonov, F. M.; Komissarova, L. N. Zh. Neorg. Khim.; 15: 875-8(Mar 1970). (In Russian).

Thermal and x-ray phase analyses were made of the reaction of hafnium and erbium oxides, and a phase diagram was constructed for the system HfO_2-Er_2O_3. The system was composed of wide fields of cubic solid solutions that were separated by narrow regions of nonmiscibility. Below 1700°C, the hexagonal compound Er_6HfO_{11} exists, which is reversibly transformed at higher temperatures to a cubic solid solution of type C. Apparently this is an order-disorder type transition. (tr-auth)

34960 SYSTEM Ta_2O_5-Gd_2O_3. Timofeeva, N. I.; Mordovin, O. A. Zh. Neorg. Khim.; 15: 865-7(Mar 1970). (In Russian).

The fusibility diagram of the system Gd_2O_3-Ta_2O_5 was studied and the presence of three congruently melting compounds established: $GdTa_3O_9$ (t_{mp} = 1840°C), $GdTaO_4$ (t_{mp} = 2050°C), and Gd_3TaO_7 (t_{mp} = 2280°C). The composition, density, microhardness, and the chemical stability of these compounds were determined. (tr-auth)

34961 THE BORIDES $HfCo_3B_2$ AND $ZrCo_3B_2$, A TERNARY $CaCu_5$-TYPE. Stadelmaier, H. H.; Schoebel, J.-D. (North Carolina State Univ., Raleigh). Monatsh. Chem.; 100: 224-30 (Jan-Feb 1969). (In German).

The ternary borides $HfCo_3B_2$ and $ZrCo_3B_2$ crystallize with the hexagonal D 2_d structure type, space group P 6/mmm, a = 4.840, c = 3.036 Å, c/a = 0.627 and a = 4.863, c = 3.043 Å, c/a = 0.625, respectively. The boron atoms are located inside a trigonal prism that is familiar from other metal-rich borides. The ternary $CaCu_5$ type has good space filling at a theoretical axial ratio c/a = 0.75 and a theoretical radius ratio of 1.5 : 1 : 0.81. (auth)

34962 SOME OBSERVATIONS ON THE MICROSTRUCTURE OF SINTERED URANIUM OXIDE PELLETS. Balaramamoorthy, K.; Chandramouli, V. A.; Date, V. G.; Gupta, U. C.; Kantan, S. K.; Sinha, K. K.; Somayajulu, G. V. S. R. K. (Bhabha Atomic Research Centre, Bombay, India). Trans. Indian Inst. Metals; 22: No. 3, 25-8(Sep 1969).

The performance of sintered uranium oxide pellets as a power-reactor fuel was found dependent to a considerable extent not only on the density of the pellets but also on the microstructure. For instance fission gas-release studies on irradiated pellets showed that the presence of interconnected pores increased the release of fission gases during reactor operation. For this reason, microstructural defects like grain size inhomogeneity (grouped porosity), segregated porosity, and porosity delineating the boundary of a granule microcracks, were defined and strict specifications regarding their occurrence in the sintered pellet were laid out depending on the power level and the thermal rating the fuel is expected to be subjected to in a particular type of power reactor. The present investigation deals with the various microstructural defects encountered in preparation of fuel pellets for the power reactor. Methods of preparation of powder and the pellets were correlated with the different types of defects observed. A procedure was finally laid out for preparing reactor grade fuel pellets, starting from a homogeneous sinterable grade uranium oxide powder. (auth)

34963 NEW DATA ON BINARY SODIUM AND THORIUM TUNGSTATES. Bushuev, N. N.; Trunov, I. V. Radiokhimiya; 12: 411(1970). (In Russian).

Thermodynamic and x-ray analyses were used for studying melting points of the Na_2WO_4-$Na_2Th(WO_4)_3$ system and binary tungstate $Na_2Th(WO_4)_3$. The constructed melt diagram of the system Na_2WO_4-$Na_2Th(WO_4)_3$ showed one incongruently melting compound $Na_4Th(WO_4)$ which at 885°C disintegrated into the liquid phase of $Na_2Th(WO_4)_3$. The eutectics had the composition of 96% Na_2WO_4 and melted at 696°C. Tabulated data showed that the intensity of the super structure lines and distortion of the lattice do not alter significantly the annealing of $Na_2Th(WO_4)_3$ at 800, 850, 900, and 950°C. At the annealing temperature of 1014°C the superstructure and lattice distortions were completely absent. The specimen of $Na_2Th(WO_4)_3$ had a shelite disordered structure (a = 5,302 and c = 11, 52 Å). (R.V.J.)

34964 ELECTRON MICROSCOPIC STUDY OF THE SUBSTRUCTURE OF VO_2 DUE TO THE MONOCLINIC TO TETRAGONICAL PHASE TRANSFORMATION. Hayashi, Y.; van Landuyt, J.; Amelinckx, S. (SCK-CEN, Mol, Belg.). Phys. Status Solidi; 39: 189-96(1 May 1970).

Vanadium dioxide has a monoclinic-tetragonal phase transformation at about 70°C. This transformation can be induced in an electron microscope during observation, and the boundaries between the monoclinic and tetragonal phases are observed by the diffraction contrast at the interfaces. When the tetragonal phase is transformed into the monoclinic one, the crystal is broken up into domains according to the different modes of transformation. The interfaces between the domains are revealed as fringe patterns in the electron micrographs. The tetragonal-monoclinic transformation boundaries and the different types of domain boundaries in the monoclinic phase are studied by electron microscopy. (auth)

34965 FIELD-ION MICROSCOPY OF URANIUM DIOXIDE. Morgan, R. (Central Electricity Generating Board, Berkeley, Eng.). J. Mater. Sci.; 5: 445-52(May 1970).

Specimens of uranium dioxide have been prepared for field-ion microscopy by diamond-sawing followed by chemical polishing and electro-polishing. Hydrogen-ion and argon-ion microscopy have been found satisfactory. Hydrogen images are slightly unstable, owing to field-induced corrosion, but argon images are completely stable at the best-image field. Argon-ion images are improved by raising the temperature of the specimen coolant from 78 to 113°K; this also causes a large reduction in the best-image voltage, owing to an improvement in the electrical conductivity of the specimen. The imaging element in hydrogen-ion micrographs is uranium. (auth) (UK)

34966 PROPOSED PHASE DIAGRAM FOR THE SYSTEM ZrO_2. Ruh, Robert (Air Force Materials Lab., Wright-

Patterson AFB, Ohio); Rockett, Thomas J. J. Amer. Ceram. Soc.; 53: 360(Jun 1970).

A phase diagram is proposed for the ZrO_2 system which is consistent with current literature data. (G.M.C.)

34967 PHASE BEHAVIOR OF THE U–V–C SYSTEM AND THE THERMODYNAMIC PROPERTIES AND CRYSTAL STRUCTURE OF UVC_2. Spear, K. E.; Leitnaker, J. M.; Lindemer, T. B. (Oak Ridge National Lab., Tenn.). High Temp. Sci.; 2: 176–97(Jun 1970).

The solid-state phase behavior and melting characteristics of the ternary U–V–C system were investigated by x-ray and metallographic techniques. The equilibrium tie lines were established, and lattice parameter data indicated ternary solid solutions involving UC and VC were slight. The existence of a ternary phase UVC_2 was confirmed, and its crystal structure was determined to be isomorphous with $UMoC_2$ by x-ray powder diffraction data and intensity calculations. The ternary compound was unstable with respect to the binary phases at temperatures above 1900 ± 100°C. The decomposition reaction and ternary reactions at lower temperatures were used to determine the free energy, enthalpy, and entropy of formation of UVC_2. (auth)

34968 MIXED OXIDES OF TITANIUM AND NIOBIUM: DEFECTS IN QUENCHED SAMPLES. Allpress, J. G. (Univ. of Melbourne, Victoria, Australia). J. Solid State Chem.; 2: 78–93(Jun 1970).

Samples of mixed oxides having the compositions $TiO_2 \cdot 26Nb_2O_5$ and $TiO_2 \cdot 7Nb_2O_5$ were quenched from temperatures near the liquids, in order to freeze in high concentrations of defects. The structure of the quenched materials was investigated by electron microscopy. Lattice images of suitably oriented fragments contain sufficient information to enable detailed structural models of the defects within them to be derived. These models indicate that the observed defects, which include Wadsley intergrowth defects and several different kinds of displacements of shear planes, are accommodated coherently and without gross misfit of the components of the structure. (auth)

Radiation Effects

Refer also to abstracts 35546, 36033, and 36041.

34969 (BMI–1882, Sect.A) URANIUM–PLUTONIUM NITRIDE FUELS FOR LMFBR APPLICATIONS. (Battelle Memorial Inst., Columbus, Ohio). 34p.

From Progress on Development of Materials and Technology for Advanced Reactors During January–March 1970.

Results of research are summarized on thermodynamics of transport in PuN and PuN–UN alloys, PuN–UN compatibility with cladding materials and coolants, composition of irradiation capsule Na bonds, diffusion in nitrides, Na bonding, cladding for PuN–UN irradiation specimens, irradiation of nitride fuels, radiation effects on PuN–UN, preparation of EBR-2 fuels, irradiation capsule safety, Treat analyses, and PuN–UN fuel swelling. (J.R.D.)

34970 (BMI–1882, Sect.C) CREEP OF REACTOR FUEL MATERIALS. (Battelle Memorial Inst., Columbus, Ohio). 22p.

From Progress on Development of Materials and Technology for Advanced Reactors During January–March 1970.

Research and development results are presented on operation of in-pile creep capsules, mechanical and thermal analyses of fuels, fabrication of PuO_2-UO specimens for creep tests, and mechanisms of creep in PuO_2-UO_2 specimens. (J.R.D.)

34971 (BNWL–1349–1, pp 2,1–39) FAST-REACTOR CERAMIC FUELS RESEARCH. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

From Reactor Fuels and Materials Development Programs for Fuels and Materials Branch.

Research and development results are summarized on creep of oxide fuels, thermal conductivity of PuO_2-UO_2, properties of fused fast reactor fuels, hot-pressing ceramic oxide fuels, lattice expansion in PuO_2-UO_2, phase studies, and O/M ratios in oxide fuels. (J.R.D.)

34972 (BNWL–1349–1, pp 3,1–69) IRRADIATION BEHAVIOR OF FAST REACTOR FUEL MATERIALS. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

From Reactor Fuels and Materials Development Programs for Fuels and Materials Branch.

Research results are summarized on in-pile thermal performance of PuO_2-UO_2 fuels, fuel–clad conductivity, fission-product Mo distribution in oxide fuels, fission product diffusion in oxides, burnup effects on fuel melting, radiation effects on PuO_2-UO_2 fuels, fuel swelling, and component diffusion in mixed oxide fuels. (J.R.D.)

34973 (BNWL–1349–1, pp 6,1–5) FAST REACTOR ABSORBER MATERIALS. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

From Reactor Fuels and Materials Development Programs for Fuels and Materials Branch.

Results of irradiation of boron carbide in thermal neutron flux are discussed. Data are also included on Ta swelling during exposure in EBR-II. (J.R.D.)

34974 (BNWL–1349–1, pp 7,1–10) NUCLEAR GRAPHITE. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

From Reactor Fuels and Materials Development Programs for Fuels and Materials Branch.

Results of investigations of graphite dimensional changes during neutron irradiation are discussed. Information is also included on graphite oxidation in HTGR, and radiolysis of H_2-CO_2–He mixtures. (J.R.D.)

34975 (EURAEC–2137) THERMAL BEHAVIOR OF URANIUM AND PLUTONIUM OXIDE CERAMIC FUELS UNDER HIGH SPECIFIC RATING IRRADIATION. Lhost, A.; van Outryve d'Ydewalle, B. (Societe Belge pour l'Industrie Nucleaire, Brussels). Nov 1969. Contract 001-64-1-TRUB. 37p. Dep. CFSTI.

Work Performed under United States–Euratom Joint Research and Development Program.

A particular variant of the technique for the vibration of dense uranium and plutonium oxide powders was developed, which consisted in introducing the latter substance only into the fine fraction of the powders. The radiation program set up to test the behavior of the produced fuels was divided into two phases: a development phase including irradiation in test reactors, and a demonstration phase made up of irradiation in power reactors. The described work is the logical follow-up of that done in 1967 on the first four irradiation runs in the BR-2 hydraulic conveyor. The overall results obtained by the irradiation of fifteen fuel rods with stainless steel cladding are presented. Moreover, the capacity values achieved in all the rods with stainless steel cladding irradiated within the framework of this program are given here; these values were obtained from the overall radio-chemical measurements achieved in different sections of the rods and the undisturbed neutron flux readings carried out during the different irradiation runs. (auth)

34976 (ORNL–4569) POSTIRRADIATION EXAMINATION AND EVALUATION OF TUNGSTEN–URANIA CERMETS. Richt, A. E.; Martin, M. M.; Martin, W. R. (Oak Ridge National Lab., Tenn.). Jun 1970. Contract W-7405-eng-26. 46p. Dep. CFSTI.

The postirradiation evaluation of tungsten-urania and tungsten-urania-thoria dispersions irradiated in the Oak Ridge Research Reactor was completed. Eight capsules were irradiated at 1500 to 1730°C and with a burnup of approximately 1.4×10^{20} fission/cm³ of the composite core. These capsules were irradiated to study the effect of type and magnitude of voids in reducing swelling of W-UO_2 and W-UO_2-ThO_2 cermets clad with a W-Re-Mo alloy. All phases of the postirradiation examination program including burnup determination, dimensional measurements, and metallographic examination were completed. The maximum increase in diameter of all eight pins ranged between 1.3 and 6.7%. Analysis of the irradiation data indicated void deployment to be less important than the total void content. End plenum void volume may have an upper effective limit of about 14%. Failure of one fuel capsule during irradiation may have been premature and caused by excessive mass transfer between fuel and cladding. (auth)

34977 MECHANISM OF COLOR CENTER DESTRUCTION IN HYDROGEN IMPREGNATED RADIATION RESISTANT GLASSES. Faile, S. P.; Roy, D. M. (Pennsylvania State Univ., University Park). Contracts AT(30-1)-2887; DA-49-083 OSA 3140. Mater. Res. Bull.; 5: 385–9(Jun 1970).

Hydrogen-impregnated glasses were found to resist radiation induced absorption in the visible and uv ranges. During irradiation the hydrogen reacted with trapped holes and electrons of color centers to form both hydroxyl and hydride groups as indicated by IR absorption studies. (auth)

Plastics and Other Materials

Refer also to abstracts 33709, 36021, and 36061.

34978 (BMBW-FBK-70-1, pp 176–200) NEW METHOD FOR MEASUREMENT OF THERMAL CONDUCTIVITY. Schmidt,

H. E.; Richter, J.; van den Berg, M. (European Atomic Energy Community, Karlsruhe (West Germany). European Transuranium Inst.). (In German).

From European Conference on Thermophysical Properties of Solids at High Temperature.

An absolute and stationary method for the measurement of longitudinal heat conduction is described for tablet shaped samples of material with low conductivity. The principle of the technique is compensation of heat conduction by a regulated electric current. With this technique measurements are performed on samples of uranium oxide and plutonium oxide with 6 mm diameter and about 1 mm thickness. The temperature range encompasses room temperature to 850°C. Data are reproducible within 5% accuracy. (tr-auth)

34979 (IITRI-C-6105-11) SCAVENGING STUDY OF SNOW AND ICE CRYSTALS. Quarterly Progress Report, February 1–April 30, 1970. Sood, Sudesh K.; Jackson, Meryl R. (IIT Research Inst., Chicago, Ill.). 11 May 1970. Contract AT(11-1)-578. 23p. Dep. CFSTI.

Scavenging efficiency of naturally precipitating snow and ice crystals for 0.234μ polystyrene latex and sodium chloride particles in the size range 0.1 to 0.16μ was studied during this report period. Experimental results showed that scavenging efficiency was a function of both the snow crystal and particle size. Some experimental work was also done to determine the scavenging efficiency of sulfur dioxide by snow. (auth)

34980 EXPERIMENTAL INVESTIGATION OF THE THERMAL CONDUCTIVITY OF AQUEOUS SOLUTION OF BORIC ACID. Popov, V. N.; Morozova, N. A. This paper was summarized in At. Energ. (USSR); 26: 371-2(Apr 1969) as paper No. 277. (In Russian).

A comprehensive study was made of the density, specific heat, thermal conductivity, and viscosity of aqueous solutions of boric acid. The experimental investigation of the thermal conductivity and its theoretical calculation is discussed. The data on density and specific heat of the solutions were used in the calculations. (auth)

34981 STUDY ON THE ELUTION OF RADIONUCLIDES FROM SOLIDIFIED WASTES. EFFECTIVE DIFFUSION COEFFICIENTS OF IONS IN SOME POROUS BODIES. Terashima, Yutaka (Kanazawa Univ., Ishikawa Prefecture, Japan); Iwai, Shigehisa; Inoue, Yoriteru; Fukui, Masami. Hoken Butsuri; 5: 13-23(Mar 1970). (In Japanese).

The leak of radionuclides from a disposed container depends on some rate processes such as the dissolution of the surface of the solidified waste and the diffusion in the solidified body and the wall of the container. Concerning the diffusion processes, several methods to determine the effective diffusion coefficient were reviewed and newly developed theoretically. Based on one of them, the effective diffusion coefficient of ^3H_2O, NH_4Cl in porous media such as cement paste, mortar, gel, and the packed bed of resin-balls were measured and compared with theory. And then the coefficients were explained in connection with the structure of these porous media with the concept of tortuosity factor. (auth) (NSA of Japan)

34982 DESIGN OF CONCRETE MIXES FOR USE IN THE TARAPUR ATOMIC POWER PROJECT. Sharma, R. C. Indian Concrete J.; 42: 155-62(1968).

Investigations made for determining the mix proportions of concrete suitable for use in this project, making use of aggregates locally available and consistent with the salient requirements of quality concrete, such as workability including cohesiveness and plasticity, strength, durability and economy, are described. (Indian Sci. Abstr.)

34983 RADIATION CAN ALTER CABLE INSULATION. Blodgett, Robert B. Elec. Light Power (Boston); 47: No. 9, 113-15(Sep 1969).

The results of tests performed to determine the effects of nuclear radiations on elastomer-based materials used for insulating electric cables are presented. (L.C.L.)

34984 SHIELDING MATERIALS FOR THE BIOLOGICAL SHIELDS OF NUCLEAR REACTORS. Komarovskii, A. N.; Dubrovskii, V. B.; Lavdanskii, P. A.; Ledenev, V. N. This paper was summarized in At. Energ. (USSR); 27: 334-5(Oct 1969) as paper No. 346/4747. (In Russian).

Results are given of investigations of the economic efficiency additives to the biological shields of nuclear reactors, which consist of magnetite, borate, and limonite ores, ferric oxide, and common sand, compared with ordinary concrete. For eight compositions of these materials the spatial distributions of neutron flux are determined in the P_1 approximation of the 18-group theory. As regards fast neutrons, the shielding parameters are best for ordinary concrete (λ = 13.38 cm) and a back-filling of limonite ore (λ = 13.6 cm) with sufficiently high hydrogen concentration and density comparable with that of the other materials considered. The energy flux distribution of captured γ-radiation shows that the fluxes are lower in materials containing more iron and less silicon. The intermediate neutrons contribute most to the dose rate (attenuation multiplicity factor: $5 \cdot 10^3$)* behind a shield with hydrogen-free fillings. The same holds true for fillings consisting of a mixture of magnetite and limonite ores which contain but little hydrogen (~3 kg/m^3). The presence of a sufficiently high hydrogen content in ordinary concrete and fillings of limonite ore, as well as the relatively low specific gravity results in the fact that the dose rate behind a shield of these substances is determined by the fluxes of external γ-radiation. The admixture of boron to shielding materials free from hydrates permits a thickness reduction of the shield by 12.5 to 20%. A biological shield for nuclear reactors consisting of all the shielding materials mentioned above is two to three times as expensive as shields of ordinary concrete. If during the period of operation the shield is not disassembled, it is economically ineffective to use biological reactor shields with additives. (auth)

PHYSICS (GENERAL)

Astrophysics and Cosmology

Cosmic Ray Exposure Ages

34985 TUNGSTEN ABUNDANCES IN TERRESTRIAL AND EXTRA-TERRESTRIAL MATERIALS BY NEUTRON ACTIVATION ANALYSIS. Amiruddin, Achmad. Lexington, Ky.; Univ. of Kentucky (1962). 155p.

Thesis.

Attempts were made to determine W in chondrites and in different separated phases of the meteorites and to study the geochemical character of the element W by neutron-activation analysis. The radiochemical separations were carried out by use of both anion exchange and gravimetric precipitations. The W abundance was determined by comparing the γ-ray photopeak counting rate of the 24 hour half-life ^{187}W in the sample and a flux monitor, which contained a known amount of W. The results obtained on seventeen chondritic meteorites, including one carbonaceous chondrite, indicate a W abundance of 0.11 (Si = 10^6 atoms) as compared to the older Suess and Urey value of 0.49 (Si = 10^6 atoms), the Cameron value of 0.105 (Si = 10^6 atoms), and a later value of 0.20 (Si = 10^6 atoms) by CLAYTON, et al. (1961). The results obtained in this work, therefore, substantiate Cameron's calculation. Comparison to the W abundances in iron meteorites, chondritic meteorites, achondritic meteorites, and troilite, indicate that the classification of the element W as lithophilic with small siderophilic character may not be accurate. The results obtained indicate that W is about equally associated with the metal phase and the silicate mineral, olivine, in the meteorites. There seems to be some correlation between W abundances in achondrites with their metal phase content. The W abundances obtained in the standard rocks G-1 and W-1 confirmed the previous results obtained by ATKINS and SMALES (1960). The result as obtained for tektites, obsidians and meteorite impact glasses indicate that, with the exception of the Libyan Desert glass, the tungsten levels in these three materials are comparable. A comparison of the abundances of W in stone meteorites, indicates that in the stone meteorites W abundances decrease with increasing SiO_2 content. This is contrary to the tungsten abundance variations found in ordinary igneous rocks. The tektites with higher SiO_2 content than either the chondrites or the achondrites, have high W abundances, and seem to follow the variation with SiO_2 content found in igneous rocks. The error of the analytical method used was too high to enable the detection of isotopic anomolies. (Diss. Abstr. Int., B)

34986 ELECTRON MICROPROBE STUDY OF METAL PARTICLES IN THE KINGFISHER METEORITE. Taylor, G. J.; Heymann, D. (Rice Univ., Houston, Tex.). Geochim. Cosmochim. Acta; 34: 677-87(Jun 1970).

Ni, Fe, and P contents were determined with an electron microprobe in five metal particles of the Kingfisher chondrite. These particles show microstructures that can best be described as very coarse plessites. The results indicate that the microstructures were formed by the transformation of preexisting α_2 phase. In the case of Kingfisher, the transformation occurred when the meteorite was reheated by shock, some 500 m. y. ago. Most of the α_2 phase was then transformed at about 600°C. If this is taken to be the residual temperature of the silicates, the shock pressure was at least 0.5 Mb. The evidence suggests that the α_2 decomposition was completed at about 450°C. The grain size of the taenite seems to imply rather slow cooling after the shock; at least some tens of years at 600°C are required for the largest grains. (auth) (UK)

Stars

34987 SPECTROSCOPIC INVESTIGATION OF VISUAL BINARIES WITH B-TYPE PRIMARIES. Murphy, Robert Earl. Cleveland; Case Western Reserve Univ. (1969). 53p.

Thesis.

The absolute magnitudes of B stars were investigated using visual binaries with B-type primaries. A new calibration is presented for the main sequence stars of types BO.5-B9 and new data on the absolute magnitudes of several classes of giants and supergiants are presented. The new main sequence calibration was obtained independently of galactic structure considerations and it is independent of previous calibrations using galactic clusters. The new main sequence is systematically fainter than that of Johnson and Iriarte (1958) but brighter than those of Weaver and Ebert (1964) and FitzGerald (1969). Four of the secondaries are peculiar A stars. Their presence in systems with main sequence B stars implies that they are not highly evolved objects. These 4 stars represent 10% of the secondaries between B9 and A7, the same percentage as is found for single field stars. At least 17 of the main sequence B-type primaries have secondaries which appear to be contracting towards the main sequence. Only 3 of those stars are in galactic clusters, the others being in the general field. Seven of the contracting secondaries are in the Hertzsprung gap, 8 others have anomalously strong hydrogen lines for their types (FO and later) and 2 have H and K in emission. (Diss. Abstr.)

34988 SPACE DISTRIBUTION AND KINEMATICS OF SUPERGIANT STARS. Humphreys, Roberta Marie. Ann Arbor, Mich.; Univ. of Michigan (1969). 170p.

Thesis.

The space distribution and kinematics of the supergiant stars of all spectral types were investigated with special emphasis on the problem of the correlation of these young stars and the interstellar gas. Specifically, the M supergiants were studied as spiral-arm tracers. New observational data, including radial velocities from infrared spectra, were obtained for 45 known M supergiants in the Perseus arm. In addition, 13 new M supergiants were found in that spiral arm. (TSS) (Diss. Abstr.)

34989 LIGHT SCATTERING IN REFLECTION NEBULAE. Hanner, Martha Safford. Troy, N. Y.; Rensselaer Polytechnic Inst. (1969). 174p.

Thesis.

Theoretical U-B and B-V colors and the B and V polarization of reflection nebulae were calculated for plane parallel slab models with various compositions and geometries. The characteristic colors and polarization computed by Mie theory for different kinds of possible interstellar grains can be readily distinguished. In general, there is also a distinct difference between models with the star in front and models having the star behind or embedded deeply in the nebula. The nebular color at 0° offset is shown to be model dependent, in part because the contribution arising from different depths in the nebula suffers different amounts of extinction. Consequently, the color at 0° can not be predicted unless the specific geometry is known, as well as the particle composition. (TSS) (Diss. Abstr.)

34990 SYNTHESIS OF LIGHT ELEMENTS IN SUPERNOVA EXPLOSIONS. Delano, Michael D. New York; New York Univ. (1969). 391p.

Thesis.

A nuclear reaction network of 903 different strong and electromagnetic reactions linking 107 chemical constituents was developed to study the synthesis of the light elements in supernova explosions. Because of the many three-body reactions included and the large size of the network, special techniques were derived for the numerical integration of the network equations. For the models tested, it was found that the light elements have very little chance of surviving the explosion. During the long freeze-out times, all the light constituents are consumed in the production of heavy elements. The resulting heavy material is so preponderant that there is a direct conflict between these supernova models and the element abundances observed in nature. This plus the possibly serious omission of neutrino momentum transport in the previous hydrodynamic calculations for these models casts doubts as to their validity and the validity of present-day theories of supernova explosions. (TSS) (Diss. Abstr.)

34991 POLARIMETRIC OBSERVATIONS OF THE RV TAURI STARS U MONOCEROTIS AND R SCUTI. Serkowski, K. (Australian National Univ., Canberra). Astrophys. J.; 160: 1107-16 (Jun 1970).

The position angle of the intrinsic polarization for U Mon remains close to 0° around and before the deep light minima and close to 105° around and before the shallow light minima that occur halfway between the deep minima. This suggests nonspherical oscillations of the star. The position angle changes abruptly at the time when doubling of the spectral lines is observed, about 14 days after each light minimum. The changes in polarization of R Sct are less regular compared with those of U Mon. For both stars the largest amounts of intrinsic polarization were observed in the ultraviolet spectral region during the light minima. (auth)

34992 INTRINSIC POLARIZATION OF EARLY-TYPE STARS WITH EXTENDED ATMOSPHERES. Serkowski, K. (Australian National Univ., Canberra). Astrophys. J.; 160: 1083-1105(Jun 1970).

Polarimetric observations were made for forty Be and shell stars. About half of these stars show evidence of intrinsic polarization, in most cases changing with time. The wavelength dependence of intrinsic polarization has maxima at wavelengths longer than the limits of the Balmer and Paschen series of hydrogen. The ratio of the amount of intrinsic polarization in the ultraviolet spectral region of the UBV system to that in the blue is about 0.5, while for interstellar polarization it is always larger than 0.7. Changes of polarization with time were found for three B-type supergiants, for the eclipsing binaries TT Hya and V453 Sco, and for the Wolf–Rayet stars θ Mus and HD 50896; for the latter star, polarization is larger in the ultraviolet than in the blue. There is no evidence of intrinsic polarization in the early-type stars which are not surrounded by extended envelopes or shells. Polarimetric observations were made for the stars for which diameters were measured with an intensity interferometer. An attempt has been made to separate intrinsic and interstellar polarization under the assumption that the color-dependence law of intrinsic as well as interstellar polarization is already sufficiently known. (auth)

34993 ZEEMAN MEASURES OF FOUR DOUBLE-LINED PECULIAR A STARS. Conti, Peter S. (Univ. of California, Santa Cruz). Astrophys. J.; 160: 1077-82(Jun 1970).

Zeeman measures of four Ap stars which are double-lined spectroscopic binaries are presented. There is no evidence for a magnetic field larger than a few hundred gauss in any of the component stars. The absence of strong magnetic fields in these stars, all of the Mn type, is another fundamental difference between this type and the well-known periodic magnetic variables of the Si and Eu–Cr–Sr types. Other established differences concern the abundances of the light elements and the iron-peak group, and the rotational velocities. There may well be different explanations for the anomalous spectral appearance of the Mn stars and the other Ap stars. The components of one binary studied, 46 Dra, are strikingly dissimilar. Both components show the Hg II line, but only the primary shows Mn II lines. These elements must be overabundant to be spectroscopically observable. (auth)

34994 THE VERY SLOW SPECTRUM, MAGNETIC, AND PHOTOMETRIC VARIATIONS OF HD 9996. Preston, George W. (Carnegie Institution of Washington, D. C.); Wolff, Sidney C. Astrophys. J.; 160: 1071-6(Jun 1970).

The Cr and Eu line intensities, magnetic field, and UBV photometric properties of the Ap star HD 9996 appear to vary in a period of 22 to 24 years. The phase relations between the various variable parameters are identical with those of well-known Ap stars with shorter periods. HD 9996 is also a single-line spectroscopic binary with a period of 273.2 d. (auth)

34995 INTERPRETATION OF δ SCUTI STARS. Leung, Kam-ching (Goddard Inst. for Space Studies, New York). Astron. J.; 75: 643-50(Jun 1970).

Consistent absolute magnitudes are obtained δ Scuti stars using Strömgren intermediate-band colors and Crawford's photoelectric Hβ indices. A period–color–luminosity relation is found for these variables and the derived contours of constant period in the color–magnitude diagram are almost parallel to the zero-age main sequence. From the locations of 34 known variables and 168 possible nonvariables, two distinct instability regions are found in the H–R diagram; the short-period group lies very close to the zero-age main sequence, while the long-period group lies about 2 mag above the main sequence. (auth)

34996 PHOTOGRAPHIC LIGHT CURVE OF THE SUPERGIANT ECLIPSING VARIABLE BL TELESCOPII. Gaposhkin, Sirgay (Harvard Coll. Observatory, Cambridge, Mass.). Astron. J.; 75: 641-2(Jun 1970).

The photometric elements and whole light curve of the unusual variable BL Telescopii are presented, based on observations taken from 1891 to 1953. (auth)

34997 UBV OBSERVATIONS OF MIRA STARS. Evans, Nancy Remage (Univ. of Toronto). Astron. J.; 75: 636-40 (Jun 1970).

New observations of 40 Mira stars at or near maximum light are presented. Photoelectric magnitudes and colors for Mira stars with $|b^{II}| > 15°$ were compiled. A color–color diagram for Mira stars at maximum light is included. (auth)

34998 FOUR-COLOR AND Hβ PHOTOMETRY FOR BRIGHT STARS IN THE SOUTHERN HEMISPHERE. Crawford, D. L.; Barnes, J. V.; Golson, J. C. (Kitt Peak National Observatory, Tucson, Ariz.). Astron. J.; 75: 624-35 (Jun 1970).

Photoelectric data on the uvby and β systems for 392 B-, A-, and F-type stars south of declination −10° are given. Many of the stars can be used as standards for southern hemisphere photometry with these systems. (auth)

34999 SPACE DISTRIBUTION AND KINEMATICS OF SUPERGIANTS. Humphreys, Roberta M. (Univ. of Michigan, Ann Arbor). Astron. J.; 75: 602-23(Jun 1970).

The distribution and kinematics of the supergiants of all spectral types were investigated with special emphasis on the correlation of these young stars and the interstellar gas. The stars used for this study were included as a catalogue of supergiants. Sixty percent of these supergiants occur in stellar groups. Least-squares solutions for the galactic rotation constants yielded 14 km sec^{-1} kpc^{-1} for Oort's constant and a meaningful result for the second-order coefficient of −0.6 km sec^{-1} kpc^{-2}. A detailed comparison of the stellar and gas velocities in the same showed good agreement, and these luminous stars occur in relatively dense gas. The velocity residuals for the stars also indicated noncircular group motions. In the Carina–Centaurus region, systematic motions of 10 km/sec were found between the two sides of the arm in agreement with Lin's density-wave theory. The velocity residuals in the Perseus arm may also be due in part to these shearing motions. (auth)

35000 HYPERON STAR MATTER. Koebke, K.; Hilf, E.; Ebert, R. (Univ. of Wuerzburg, Ger.). Nature (London); 226: 625-6(16 May 1970).

Hyperon stars are neutron stars with a superdense core ($\rho > 10^{15}$ g cm^{-3}) consisting chiefly of baryons and heavier resonances. The equation of state for such a multicomponent system is determined by the elementary-particle spectrum. This spectrum is known to be exponential up to about 2 GeV. Assuming the exponential behaviour to continue beyond 2 GeV, and taking into account the fermions only, then the equation of state becomes temperature-dependent because the heaviest components are partially nondegenerate. If the core of the hyperon star is in general-relativistic thermal equilibrium, the polytropic index of the relation between pressure and total density (including kinetic energy) proves to be negative. As a consequence, the velocity of sound in the radial direction, defined by $v_s = \sqrt{(dp/d\rho)}$ decreases towards the centre instead of exceeding the velocity of light. Under the additional hypothetical supposition that the mass spectrum remains exponential up to infinity (infinite energies), in hyperon stars the temperature cannot exceed a limiting temperature of $T_0 = 2 \times 10^{12}$K and the time component g_{00} of the metric tensor of space–time cannot become zero. (auth) (UK).

35001 /NON-LTE MODEL ATMOSPHERES. V. MULTILINE HYDROGEN-HELIUM MODELS FOR O AND EARLY B STARS. Mihalas, Dimitri (Univ. of Chicago); Auer, L. H. Astrophys. J.; 160: 1161-76(Jun 1970).

Results of calculations of non-LTE model atmospheres including the effects of Lα, Lβ, Lγ, Hα, Hβ, and Pα are presented for models on the range $25{,}000°K \leq T_{eff} \leq 50{,}000°K$, with $\log g = 4$ and $N(He)/N(H) = 0.10$. The non-LTE results suggest a severe breakdown of LTE at $T_{eff} \geq 35{,}000°K$. Substantial changes occur in the far-ultraviolet fluxes; these may be of importance in the interpretation of the excitation of emission nebulae. In the visible, the Balmer jump is significantly increased by non-LTE effects for models with $T_{eff} \geq 35{,}000°K$, which implies large changes in effective temperatures for O stars inferred from observations of the Balmer jump. Striking changes occur in the hydrogen-line profiles. When non-LTE effects are included, Hα and Hβ are computed to be almost 3 times as strong at 40,000°K as in LTE. Pα is found to have an emission core in the highest-temperature models. This result is analogous to the situation at lower temperatures where Bα is computed to go into emission. In both cases the emission core is due to coupling to a rise in surface temperature in the non-LTE models; observations are desirable to test the reality of this predicted effect. (auth)

35002 PHOTOELECTRIC MEASUREMENT OF LUNAR OCCULTATIONS. III. LUNAR LIMB EFFECTS. Evans, David S. (Univ. of Texas, Austin). Astron. J.; 75: 589-99(Jun 1970).

The problem of interpretation of occultation traces is reconsidered in the light of modern techniques of observation and computation, with special reference to the effects of irregularities on the lunar limb and their discrimination from effects due to intrinsic properties of occulted stars. General diffraction formulas are developed and several series of computed cases are considered. Errors of timing due to limb irregularities are investigated. It is concluded that the time deduced from the standard curve of best fit to the observed trace probably represents a timing appropriate to an average limb height taken over some 20 meters in the neighborhood of the point of geometrical occultation. Tests of somewhat limited applicability can be devised to identify cases where lunar limb irregularities have produced distortion of traces. One statistical test fails to reveal any definite indication of the presence of distortion in the traces obtained up to the fall of 1969. There remain some traces which show features which could be interpreted

as due to distortion by limb effects. The use of two-color observations for the discrimination of limb effects from stellar effects is discussed. Necessary conditions for the interpretation of features of two-color observations, as due to duplicity or the presence of a sensible angular diameter, are stated. (auth)

35003 PHOTOELECTRIC MEASUREMENT OF LUNAR OCCULTATIONS. II. INSTRUMENTATION. Nather, R. Edward (McDonald Observatory, Austin, Tex. Univ. of Texas, Austin). Astron. J.; 75: 583-8(Jun 1970).

The equipment used for occultation observations is designed around a 400-channel multiscaler. The light from the star and scattered moonlight falls on a cooled 1P21 photocell from which the output signal passes to a voltage-to-frequency converter which converts the signal level to pulses. These are counted into a channel of the multiscaler for a fixed interval of time, usually 1 ms, but for some observational conditions, 2 or 4 ms. The accumulation is advanced to the subsequent channel under the control of 1-kHz pulses from the observatory clock which is compared with WWV signals. The multiscaler is modified so that when the 400th channel is passed, the output is immediately switched to the first channel and substitutes the new record for that already stored in that memory channel. By continuing this cycling process, a continuous digital record is kept of the light level for the preceding 0.4 sec of time, at, normally, 1-ms intervals. The process is stopped by the change of level associated with the occultation whether for disappearance or, by a different switch setting, for reappearance. A time delay, usually of 0.1 sec, is incorporated to permit recording of all portions of the light curve required for analysis. Direct digital recording in this form has the marked advantage over any other method of presenting the data in a form adapted to routine analysis. The equipment works very well in a completely routine fashion. The limiting magnitude attainable with the 36-inch telescope varies with lunar phase and the intensity of atmospherically scattered light, but stars as faint as 9.4 have been observed. Little purpose would be served by observing timings for still fainter stars since their positions are uncertain and data of astrophysical importance are unlikely to be secured for stars as faint as this. (auth)

35004 PHOTOELECTRIC MEASUREMENT OF LUNAR OCCULTATIONS. I. THE PROCESS. Nather, R. Edward; Evans, David S. (McDonald Observatory, Austin, Tex. Univ. of Texas, Austin). Astron. J.; 75: 575-82(Jun 1970).

The history of previous work on the determination of angular diameters of stars and the associated study of diffraction patterns produced by lunar occultations is reviewed. Other applications, to ephemeris theory, to astrometry, and to the detection of very close binaries are mentioned. The effects of bandwidth, telescope diameter, and spectral type on the diffraction patterns are discussed. The effects on time scale of the angle of the vertex of relative lunar motion, of latitude, and of hour angle are considered. The observation of occultations from Earth-orbiting spacecraft is mentioned. The application of the occultation technique is limited by the natural selection of stars, by the level of scattered moonlight, and by scintillation. Distortion of traces by lunar limb effects is mentioned as also are timing errors due to elevations and depressions of the lunar limb. A preliminary discussion of the type of data obtainable from observations of close double stars with "vector separations" of the order of a few arc milliseconds is given. The importance of cooperative observations at several different observatories is emphasized. A final section discusses the determination of angular diameters of stars with special reference to the selection of those likely to yield sensible values. (auth)

35005 INTERNAL MOTIONS IN THE PLEIADES. Jones, Burton F. (Yerkes Observatory, Williams Bay, Wis.). Astron. J.; 75: 563-74(Jun 1970).

New relative proper motions were obtained for 92 stars in the Pleiades region from plates taken with the Yerkes 40-inch refractor. These proper motions were used with the virial theorem to obtain a mass of 690 $M_\odot$ for the cluster. An analysis of the dispersions in the proper motions showed that it is unlikely that there is equipartition of kinetic energy among the stars of various masses. The dispersions also showed that stars far from the cluster center are in highly eccentric orbits. From an analysis of proper motions obtained from two plates taken with the 20-inch Carnegie astrograph of the Lick Observatory, it was concluded that the cluster has a flat luminosity function to at least $M_v = 12$. (auth)

35006 THE TRANSIT-TIME EFFECT IN WOLF-RAYET BINARIES. Castor, John I. (Univ. of Colorado, Boulder). Astrophys. J.; 160: 1187-9(Jun 1970).

It is demonstrated that the transit-time effect in Wolf-Rayet binaries is negligible in all cases of interest. This conclusion is reached by calculating the exact motion of particles ejected from the Wolf-Rayet component of the binary system. (auth)

35007 A CURVE-OF-GROWTH ANALYSIS OF THE SUPER-METAL-RICH G DWARF HR 72. Spinrad, Hyron; Luebke, William R. Jr. (Univ. of California, Berkeley). Astrophys. J.; 160: 1141-8(Jun 1970).

A conventional curve-of-growth comparison was made between HR 72, a strong-line G dwarf, and the Sun. HR 483 and β Com were also observed as controls. HR 72 is only slightly hotter than the Sun ($\Delta\theta = -0.015$); it is very metal-rich, with [Fe/H] = +0.43. Apparently, all metals are overabundant from Na to possibly La. The overabundances of the light elements C and N may be deduced from the star's strong molecular bands of CN, CH, and C_2. HR 72 may be considered a prototype super-metal-rich (SMR) dwarf; recently noted supermetallicity in giants is then very likely due to their original composition rather than to some form of self-enrichment of heavy elements. (auth)

35008 EFFECTIVE TEMPERATURES, GRAVITIES, AND THE MASS DETERMINATION OF A AND F STARS. Breger, Michel; Kuhi, Leonard V. (Univ. of California, Berkeley). Astrophys. J.; 160: 1129-39(Jun 1970).

The popular method of determining stellar masses by fitting model atmospheres to observed stellar energy distributions and using photometric (narrow-band) absolute magnitudes is based on a circular argument and is not valid. The method of obtaining and the sources of error in obtaining effective temperatures and gravities by fitting observed energy distributions to theoretical model fluxes are discussed. Measured blanketing values are shown to be dependent on rotational velocity, v sin i. This is interpreted as a depression of the true continuum by blending of rotationally widened lines. Energy distributions were measured with a spectrum scanner for eight variable and twelve nonvariable A and F stars in and near the lower instability strip. Values of effective temperature and gravity were obtained. There is excellent agreement between effective temperatures derived from the infrared/red slope and the energy distribution in the blue. The new Hayes calibration gives a reasonable mean mass ~2 $M_\odot$ for the stars in the instability strip. Hence, pulsation in a high harmonic is not needed to explain the δ Scuti stars. The borders of the instability strip intersect the main sequence near $\theta_e = 0.60$ and 0.68. An attempt is also made to reconcile previously published results. (auth)

35009 THE PECULIAR HIGH-VELOCITY STAR HD 204613. Bond, Howard E. (Louisiana State Univ., Baton Rouge). Astrophys. J.; 160: 1127-8(Jun 1970).

The early G-type star HD 204613 is kinematically a member of the galactic halo, yet it is not extremely weak-lined and, in fact, appears to show greatly enhanced abundances of certain elements. Photometrically, it is similar to the giants in M92 that show only a small ultraviolet excess. (auth)

35010 THE SPECTRUM OF RW AURIGAE, 3250 TO 4900 A. Gahm, Goesta F. (Univ. of California, Santa Cruz). Astrophys. J.; 160: 1117-25(Jun 1970).

A catalog of emission and absorption lines and line intensities derived from three coudé spectrograms of RW Aurigae covering the wavelength region 3250 to 4900 Å is presented. Anomalous line intensities are discussed, and the presence of several fluorescent processes is suggested. (auth)

35011 THE PLANETARY NEBULA BD + 30°3639. O'Dell, C. R. (Yerkes Observatory, Williams Bay, Wis.); Terzian, Yervant. Astrophys. J.; 160: 915-20(Jun 1970).

A new measurement of the Hβ emission-line flux from BD + 30°3639 is reported and this is combined with the existing radio data to discuss the physical nature of this unusually low-excitation planetary nebula. The radio continuum indicates that the spectrum is thermal and self-absorbed, with a turnover frequency of about 4 GHz, a feature that is expected from the very high optical surface brightness. The interstellar extinction is not satisfactorily determined, because the results of usually reliable and different approaches give significantly different results. The conditions of temperature, density, and luminosity are derived and are found to be very much like those of other compact planetary nebulae. It is found that most of the unusual characteristics reported previously result from the utilization of an early photoelectric Hβ flux that was in error by a factor of 31. (auth)

35012 THE LARGE VARIABLE MAGNETIC FIELD OF HD 126515 AND ITS IMPLICATIONS FOR THE RIGID-ROTATOR MODEL OF MAGNETIC STARS. Preston, George W. (Carnegie Institution of Washington, D. C.). Astrophys. J.; 160: 1059-70(Jun 1970).

The mean surface field H_s of the Sr-Cr-Eu star HD 126515 var-

ies approximately sinusoidally between 10 and 17 kilogauss in a period of 130.0d. The effective field H_e oscillates between −2 and +2 kilogauss with a single wave in the same period. From the point of view of the rigid-rotator model, these results require that the star has a hemispherically asymmetric magnetic field, the principal features of which are represented by a dipole displaced from the center of the star in the direction opposite to its moment by 0.36 stellar radii. HD 126515 is also a spectrum variable, and the phase relations between the line intensity and H_e variations indicate in a general way that the heavy elements are concentrated in regions where the surface field is strongest. (auth)

35013 THE QUADRATIC ZEEMAN EFFECT AND LARGE MAGNETIC FIELDS IN WHITE DWARFS. Preston, George W. (Carnegie Institution of Washington, D. C.). Astrophys. J.: 160: L143-5(Jun 1970).

Comparison of the displacements of absorption lines in the spectra of white dwarfs with those produced by the quadratic Zeeman effect indicates that few if any white dwarfs with measurable absorption lines have surface magnetic fields as large as 5×10^5 gauss. (auth)

35014 MAGNETIC OBSERVATIONS OF WHITE DWARFS. Angel, J. R. P.; Landstreet, J. D. (Columbia Univ., New York). Astrophys. J.: 160: L147-52(Jun 1970).

A search was made among the brighter DA-type dwarfs for magnetic fields by using a new, highly sensitive photoelectric polarimeter. No magnetic fields were detected in the nine stars so far observed, and upper limits of about 10^5 gauss can be placed on fields that may be present. (auth)

35015 MODEL ATMOSPHERE ANALYSIS OF THE Ap STAR $\varkappa$ CANCRI. Aller, M. F. (Univ. of Michigan, Ann Arbor). Astron. Astrophys.; 6: 67-84(May 1970).

A detailed model-atmosphere analysis is presented for the peculiar A star $\varkappa$ Cancri based on high-dispersion spectrograms secured at the coudé focus of the Lick 120-inch telescope and a published energy distribution. The observed energy distribution and hydrogen-line profiles indicate that the atmosphere can be represented by a model with $\theta = .36$ at $\log \tau_{5000} = 0.0$ and with $\log g = 3.6$. The metal-line equivalent widths, half widths, and central line depths served to determine the stellar abundances and to further verify the model. A micro-turbulent velocity of 5 km/s was established from the shapes of the metal-line profiles, from the abundance–equivalent width correlations and from the shape of the curve of growth. The analysis shows that phosphorus is overabundant by a factor of 300, manganese by a factor of 200, gallium by a factor of 2000, and mercury and xenon by factors of 10^3 or more. Helium is underabundant by a factor of 2, magnesium by a factor of 6 and calcium by a factor of 30. Among the iron-peak elements, titanium and scandium are overabundant, iron is marginally overabundant, and chromium and nickel are marginally underabundant. The composition of $\varkappa$ Cancri is similar to that of 3 Cen A and other manganese stars. The extent of the manganese overabundance in each manganese star may be correlated with its effective temperature. (auth)

35016 SPECTROSCOPIC INVESTIGATION OF B3V STARS: ι HERCULIS, η HYDRAE, HD 58343. Kodaira, K.; Scholz, M. (Carnegie Institution of Washington, D. C. California Inst. of Tech., Pasadena). Astron. Astrophys.; 6: 93-113(May 1970).

New observations of ι Her (B3V, $v \sin i = 0$ km/s), η Hya (B3V, 130 km/s), and HD 58343 (HR 2825; B3Ve, 35 km/s) are reported and interpreted by means of LTE model-atmosphere techniques. The Balmer jumps point to lower effective temperatures than the ionization equilibria of four pairs of ions. The choice of gravity depends strongly on the adopted hydrogen broadening theory. In ι Her, the microturbulent velocity is $\xi_t \cong 5$ km/s. Fine analyses are carried out for models with $T_{eff} = 20200°$K, $\log g = 3.75$, $\xi_t = 5$ km/s (ι Her and HD 58343), and 21900°K, 4.0, 5 km/s (ηHya), respectively; Mihalas' unblanketed models and the KG theory for Balmer lines are used. No differences between the chemical compositions of stars with different rotational velocities are found, with the possible exception of C and Ne. Most elements have solar abundances. With $\log \epsilon_{He} = 10.8$, a satisfactory interpretation of most helium lines can be given. The iron abundance is $\log \epsilon_{Fe} \cong 7.4$. In ι Her, neon is overabundant. The deep cores of the Balmer lines and certain strong He I lines ($\lambda\lambda$ 6678, 5876, 4471, 4026) cannot be interpreted by a simple LTE theory. Effects of gravity darkening are studied. The envelope spectrum of HD 58343 is discussed. (auth)

35017 HYDROGEN LINES IN A B-TYPE SUPERGIANT. Underhill, A. B. (Astronomical Inst., Utrecht). Astron. Astrophys.; 6: 114-23(May 1970).

Observations of the Hγ profile in the supergiants β Orionis, B8Ia, η Canis Majoris, B5Ia, o^2 Canis Majoris, B3Ia, and ϵ Orionis, B0Ia, are presented as well as observations of the confluence of the Balmer series. The Hγ profiles of these four stars are remarkably alike, differing significantly only in the core, $\Delta\lambda < 1.5$ Å. It is shown that the break off of the Balmer and of the Paschen series must be due chiefly to Stark effect and it is estimated that the electron density in layers where the wings of the hydrogen lines are formed probably lies in the range $10^{12} < N_e < 10^{13}$. This corresponds to models with log g about 2.0. A simple theory based on the one-layer hypothesis is developed to investigate the effects of temperature, electron density, and relative helium content on the extent of the wings of the Balmer lines. It is shown that the extent of the wings is a sensitive function of temperature at least through the range 12000° < T < 18000°K, the wings decreasing significantly as T is increased. If the helium content is increased to more than 10 × the normal content, the wings decrease significantly, other factors remaining unchanged. No secure conclusion can be made about the helium content in the Ia supergiants of type B until the temperature in the wing-forming layers of the atmosphere is known accurately. The similar shape of the Balmer lines in all four supergiants is remarkable considering the temperature dependence indicated by the simple theory developed here and by non-LTE model-atmosphere calculations of Strom and Peterson, because the spectral type classification lines in these supergiants do change in strength significantly giving types from B8 to B0. It seems that motion broadening determines the shape of the wings in Ia supergiants even though the electron density is not particularly low, N_e being $\gtrsim 10^{12}$. (auth)

35018 MECHANISM OF FORMATION OF SEMI-CONVECTIVE ZONE IN STARS. Gabriel, M. (Institut d'Astrophysique, Liege). Astron. Astrophys.; 6: 124-9(May 1970).

After a criticism of the ability of overstable convection to give rise to semi-convective zones in massive stars, a new mechanism is presented. In the frame of this theory, the models for massive stars are identical to those proposed by Schwarzschild and Härm. (auth)

35019 DISTANCE SCALE OF THE NEAR-BY CLASSICAL CEPHEIDS. Jung, J. (Observatoire, Paris). Astron. Astrophys.; 6: 130-7(May 1970).

On the basis of new proper motions data, the distance scale of the Cepheids derived from the cluster Cepheid method was checked by applying the method of maximum likelihood (June, 1969) to a sample of 33 nearby Cepheids ($r \leqq 1$ kpc). Special attention was paid to the determination of interstellar absorption. The corrections of extrinsic unreddening are discussed. The method of maximum likelihood gives a systematic correction to the period–luminosity relation as given by Sandage and Tammann (1968), of about 0.4 (± 0.4, standard deviation), after taking into account the bias caused by errors on the proper motions. It is stressed that the method of maximum likelihood could, in principle, give an accuracy of about ±0.2, if the sample were extended to all Cepheids closer than 2.3 kpc, provided the probable errors on the proper motions were known with sufficient accuracy. (auth)

35020 RELATIVE METAL-TO-HYDROGEN RATIO FOR THE SUN, HYADES, AND 53 F5–G2 STARS. Nissen, P. E. (Goddard Inst. for Space Studies, New York. Kitt Peak National Observatory, Tucson, Ariz.). Astron. Astrophys.; 6: 138-50 (May 1970).

A new method to determine the metal-to-hydrogen ratio in stars based on photoelectric observations of the strength of a group of weak metal lines in a band of the width of 3.5 Å near 4800 Å is described. The method was applied at the 60-inch Robert McMath Solar Telescope and through a model-atmosphere analysis of the observations [Fe/H] values between −0.3 and 0.6 for 53 F5–G2 stars were derived. The mean error of [Fe/H] is ±0.06 for stars of magnitude four to six for an observation time of 15 minutes. Calibration of Strömgren's Δm_1 index gives $[Fe/H] = -12.7\,\Delta m_1 + 0.41$ for F5–G2 main-sequence stars. Nine Hyades stars were observed and the average value of [Fe/H] found to be 0.38 ± 0.02 if recent determinations of the color index of the Sun, (B − V) = 0.666, are correct. Comparison between the [Fe/H] values and a photoelectric index of the microturbulence velocity in the atmospheres of F and G main-sequence stars shows that the turbulence parameter is not an independent atmospheric parameter. (auth)

35021 SHILT'S METHOD: APPLICATION TO STELLAR PHOTOMETRY WITH THE ELECTRONIC CAMERA. Bijaoui, A.; Dantel, M. (Observatoire, Paris). Astron. Astrophys.; 6: 51-9(May 1970).

The application of the electronic camera to stellar photometry allows one to retain almost all the advantages of both classical photographic plate and those of photomultiplier characteristics. On the one hand, this light receiver allows one to determine the luminosity of all the stars in the area up to a large magnitude;

on the other hand, it is a linear receiver and its spectral response does not depend on the luminous flux. The limiting magnitude determined by signal-to-noise ratio is obtained with signal filtering of the stellar structure. Thus, it is a detection by means of a matched filter. (W.D.M.)

35022 RADIAL VELOCITIES OF THE X-RAY CANDIDATE STAR S5003 CENTAURI. Feast, M. W. (Radcliffe Observatory, Pretoria). Astrophys. J.; 160: L171-2 (Jun 1970).

No large variations in radial velocity were detected for Hα emission in S5003 Cen for the period February 27–April 1, 1970. However, there is a large change in velocity compared with observations by Eggen and Rodgers in September 1969. (auth)

35023 THE SPECTRUM OF VY CANIS MAJORIS FROM 2.9 TO 14 MICRONS. Gillett, F. C. (Univ. of California, San Diego); Stein, W. A.; Solomon, P. M. Astrophys. J.; 160: L173-6 (Jun 1970).

The bright infrared object VY CMa has been observed from $\lambda = 2.9\ \mu$ to $\lambda = 14\ \mu$ with a resolution $\Delta\lambda/\lambda = 0.01$ to 0.02. Three independent observations show an absorption feature extending from about $\lambda \approx 7.7\ \mu$ to $\lambda \approx 9\ \mu$. Preliminary analysis indicates that the band can be attributed to SiO molecules in the extended atmosphere of the star. It is difficult, however, to reconcile these results with previous models that have been suggested for the object. (auth)

35024 INFRARED OBSERVATIONS OF NOVA SERPENTIS 1970. Hyland, A. R.; Neugebauer, G. (Carnegie Institution of Washington, D. C.). Astrophys. J.; 160: L177-80 (Jun 1970).

Preliminary infrared observations of Nova Serpentis 1970 show that the total luminosity remained fairly constant while the visual luminosity decreased about 3.5 mag. (auth)

35025 THE ANGULAR DIAMETER OF LAMBDA AQUARII. Nather, R. Edward; McCants, Michael M.; Evans, David S. (Univ. of Texas, Austin). Astrophys. J.; 160: L181-4 (Jun 1970).

An occultation observation of λ Aqr gives an angular diameter between 0.0074 and 0.0082″ according to the assumed law of darkening. The observational uncertainty is of the order of ±0.0004″ in each case. The range of values arises not from errors of observation but from the range of choice for the limb-darkening coefficient, which is not normally determinable from occultation observations. Nor is it usually possible even to determine whether a cosine law of darkening is valid. If the cosine law is assumed, the effective temperature lies in the range 3250 to 3450°K whatever value of the darkening coefficient is adopted. (auth)

35026 CV SERPENTIS HAS STOPPED ECLIPSING. Kuhi, L. V.; Schweizer, F. (Univ. of California, Berkeley). Astrophys. J.; 160: L185-7 (Jun 1970).

The Wolf–Rayet eclipsing binary CV Ser was observed around the cycle in the light of both continuum and emission lines, and no eclipses were found. (auth)

35027 INFLUENCE OF OPACITY ON THE PULSATIONAL STABILITY OF MASSIVE STARS WITH UNIFORM CHEMICAL COMPOSITION. Stothers, Richard; Simon, Norman R. (Goddard Space Flight Center, New York). Astrophys. J.; 160: 1019-29 (Jun 1970).

The maximum mass of homogeneous stars which are stable against nuclear-energized pulsations was redetermined by using a full-opacity formula and an accurate treatment of the equilibrium structure of the outer layers where nonscattering sources of opacity are important damping agents. Sixteen composition mixtures were used, covering the range $0 \le Y \le (1 - Z)$ and $0 \le Z \le 0.05$. The nuclear-energy sources were taken to be the CN cycle and the triple-α process. Due to the primary influence of bound–free absorption by metals (and, to a lesser extent, of free–free absorption by hydrogen and helium), the critically stable nondimensional mass of hydrogen-burning stars, $(M/M_\odot)\mu^2$, can range from 27 to 94, depending on the chemical composition. For likely chemical compositions of extreme Population I, the actual critical mass is probably 80 to 120 $M_\odot$. For homogeneous helium-burning stars, the critical mass ranges from 13 to 19 $M_\odot$, depending on the metal abundance. (auth)

35028 NONLINEAR PULSATIONS AND STABILITY OF SLOWLY ROTATING STARS. Tassoul, Jean-Louis (Univ., Montreal). Astrophys. J.; 160: 1031-42 (Jun 1970).

Finite-amplitude oscillations of slowly rotating, slightly distorted stars are considered. Lagrangian variables and the scalar virial theorem are employed to describe, in a first approximation, nonlinear adiabatic motions which, in the limit of zero rotation, are purely radial. The linear approximation predicts that the critical adiabatic exponent γ at which dynamical instability sets in, γ_L, is reduced from $\frac{4}{3}$ by rotation; the present nonlinear theory shows that, for $\gamma_L < \gamma < \frac{4}{3}$, stability depends crucially on the initial amount of kinetic energy available to maintain the pulsations. Actually, for $\gamma_L < \gamma < \frac{4}{3}$, oscillatory motions exist only when the amplitudes remain less than a certain critical value; for larger initial velocities, a rotating star expands from its equilibrium state. In contrast to the usual linear prediction, such an expanding motion eventually becomes uniform in time. Finally, irrespective of initial velocities, all nonlinear pulsations are stable when $\gamma \ge \frac{4}{3}$, and monotonically increase with time when $\gamma \le \gamma_L$. (auth)

35029 THE INSTABILITY OF THE CONGRUENT DARWIN ELLIPSOIDS. II. Chandrasekhar, S. (Univ. of Chicago). Astrophys. J.; 160: 1043-8 (Jun 1970).

The resonant oscillations of one of two congruent Darwin ellipsoids, forced by the natural oscillations of the other, are considered; and the instability of the ellipsoids to synchronous coupled oscillations is traced to this resonance. (auth)

35030 THE MAGNETIC FIELD OF β CORONAE BOREALIS. Wolff, Sidney Carne; Wolff, Richard J. (Univ. of Hawaii, Honolulu). Astrophys. J.; 160: 1049-58 (Jun 1970).

Measurements of resolved Zeeman patterns in the spectrum of β CrB show that $|H_s|$, the mean surface magnetic field, varies approximately 180° out of phase with the longitudinal component of the field H_e. The maximum observed $|H_s|$ is about 5700 gauss, and the total amplitude of the variation is 800 gauss. The observations are compatible with a field geometry in which one magnetic pole is stronger than the other. (auth)

35031 NUCLEOSYNTHESIS IN SUPERNOVA MODELS. I. THE NEUTRINO-TRANSPORT MODEL. Arnett, W. David; Truran, J. W. (California Inst. of Tech., Pasadena). Astrophys. J.; 160: 959-70 (Jun 1970).

A critical analysis is presented of the nucleosynthesis conditions predicted by supernova models built upon the mechanism of the transport of energy by neutrinos. At the extreme densities ($\sim 10^{11}$ g cm^{-3}) demanded in these models to ensure that neutrinos leaving the core will interact with the surrounding medium, a substantial neutron enrichment occurs ($\bar{N}/\bar{Z} \sim 2$) in the ejected material. The subsequent thermonuclear processing of this material is found to result in the production of very massive nuclei ($A > 60$). These conditions are found to occur in a total mass of $\sim 0.5\ M_\odot$ in each such event. The assumption that all observed supernova explosions correspond to events of this type leads to the conclusion that the mass fraction of these heavy elements in the Galaxy is in excess of 10^{-3}, in conflict with a solar-system value of $\sim 5 \times 10^{-6}$. It is concluded that events of this type cannot constitute any substantial fraction of the supernovae observed. (auth)

35032 STELLAR WINDS. Goldreich, Peter (California Inst. of Tech., Pasadena); Julian, William H. Astrophys. J.; 160: 971-7 (Jun 1970).

Relativistic analytic solutions are presented for the model stellar-wind problem posed by Weber and Davis. These solutions are consistent with the hypothesis of minimum torque proposed by Michel, but do not require it as an additional assumption. The equation of radial momentum has three critical points which occur where the radial flow velocity is equal to the propagation speed of infinitesimal disturbances. A unique continuous solution is determined by the requirement that it pass through all these critical points. (auth)

35033 CHEMICAL ABUNDANCES AND THE PARAMETERS OF PLANETARY NEBULAE. Kaler, James B. (Univ. of Illinois Observatory, Urbana). Astrophys. J.; 160: 887-913 (Jun 1970).

All known existing observations of spectral-line intensities of planetary nebulae were compiled into a catalog that consists of 250 nebulae, including four well-observed H II regions. New electron densities were calculated for most of these nebulae, and revised electron temperatures from the [O III] lines are given for 109 of them. The ratios He/H, O/H, and O^{2+}/H^+ are given for 80, 124, and nearly all the nebulae, respectively. A two-temperature model is assumed for the calculation of abundances, in which the low temperatures derived from the hydrogen lines and continuum are used for hydrogen and helium recombination coefficients, and the [O III] temperatures are used for the calculations involving forbidden lines. Various methods of calculating the abundance of the higher ionization stages of oxygen are evaluated, and the method of using the He^{2+}/He^+ ratio is found to give the most consistent results. The intensities of the [Ne IV] and [Ne V] lines suggest a high electron temperature near the central star. The [O III] electron temperatures are correlated negatively with the O/H ratio and positively with the temperature of the central star in accord with the currently accepted ideas of nebular heating and cooling. The mean [O III] electron temperature is 11,500°K for nebulae without He II lines and 14,000°K for those with He II lines. The mean O/H ratio is 5.35×10^{-4} and ranges from about 10^{-4} to 1.4×10^{-3}. The mean He/H ratio is 0.14 with a range of from 0.09 to greater than 0.2.

The O/H ratio is negatively correlated with the He/H ratio, and is also correlated with population indicators such as radial velocity and height above the galactic plane in the sense that objects with high O/H have Population I characteristics and the nebulae of Population II have low O/H. In view of these results it would appear difficult to interpret the data in terms of "cosmic abundances." (auth)

35034 SOME FORBIDDEN-LINE INTENSITY RATIOS IN GASEOUS NEBULAE. Krueger, T. K. (General Physics Lab., Wright-Patterson Air Force Base, Ohio); Aller, L. H.; Czyzak, S. J. Astrophys. J.; 160: 921-7(Jun 1970).

The equations of statistical equilibrium for the ground $3p^3$ configuration of the isoelectronic sequence S II, Cl III, Ar IV, are solved as a function of T_e and N_e over the range of values normally encountered in gaseous nebulae. Applications to observed line ratios, e.g., I(λ6716)/I(λ6730)/and I(λ4068)/[I(λ6730) + I(λ6716)] of [S II] are made for typical nebulae. (auth)

35035 SPECTROPHOTOMETRIC STUDIES OF GASEOUS NEBULAE. XVI. THE MODERATELY HIGH-EXCITATION PLANETARIES IC 2003, NGC 2022, AND CD -23°12238. Aller, L. H. (Univ. of California, Los Angeles); Czyzak, S. J. Astrophys. J.; 160: 929-38(Jun 1970).

Line-intensity data and corresponding electron densities, temperatures, and ionic concentrations are presented for a number of nebulae that seem to have relatively simple spatial structures. (auth)

35036 THEORETICAL CONTINUOUS SPECTRA OF GASEOUS NEBULAE. Brown, Robert L.; Mathews, William G. (Univ. of California, San Diego). Astrophys. J.; 160: 939-46(Jun 1970).

Tables are given from which the continuous spectrum of emission nebulae can be computed from a knowledge of the electron temperature, the electron density, and the abundance of helium ions. The recombination continua of He I are determined from photoionization cross sections calculated by the quantum-defect method as described by Peach. Total recombination coefficients to low levels of He^0 are also computed. (auth)

35037 SYSTEMS WITH NEGATIVE SPECIFIC HEAT. Thirring, W. (CERN, Geneva). Z. Phys.; 235: 339-52(1970).

Some systems for which the binding energy increases more rapidly than linearly with the number of particles, are shown to exhibit negative specific heat c for some energies. In thermal contact with larger systems, $c < 0$ creates an instability, and in the canonical ensemble one sees only a phase transition. It is argued that supernovae are, in essence, a phase transition of this origin. (auth)

35038 GRAVITATIONAL COLLAPSE OF SLIGHTLY NONSPHERICAL MASSES. Patashinskii, A. Z.; Kharkov, A. A. (Novosibirsk State Univ., USSR). Dokl. Akad. Nauk SSSR; 190: 1074-7(11 Feb 1970). (In Russian).

It has been found earlier that in the gravitational collapse of slightly nonspherical bodies, the general properties of the metric outside of the body are identical with that prevailing during the collapse of a sphere and may be derived from the spherically symmetric portion of the metric. There is also a small nonspherical and time-attenuated contribution to the metric. Passage of a gravitational radius r_g in the accompanying system does not induce a field in it. This problem was more closely examined, assuming that all characteristics of the body possess an axial symmetry. The mathematical method was based on the initial assumption of the perturbation of the Schwarzschild metric, transforming the solution by Lemaitre's transform, in order to obtain a better approximation. The results revealed that the effects of nonsphericity disappear in the external space exponentially with time. (TTT)

35039 SPECTRUM OF THE EMISSION STAR HBV 475 IN THE NEAR-INFRARED. Andrillat, Yvette (Montpellier Univ., France). Compt. Rend., Ser. B; 270: 1066-9(20 Apr 1970). (In French).

The spectrum of the variable star HBV 475 shows strong emissions in the near-infrared due to H, He I, O I, and Ca II. TiO is identified in absorption. The continuum may be compared to that of an M4-type star. This investigation, therefore, seems to confirm the symbiotic nature of this star, which in other spectral fields, is concealed by many emissions. (France)

35040 DYNAMICS OF SELF-GRAVITATING SPHERES. Barnes, A.; Whitrow, G. J. (Imperial Coll. of Science and Tech., London). Mon. Notic. Roy. Astron. Soc.; 148: 193-5(1970).

It is shown that the analytical results obtained by Penston (1969) for the Newtonian pressure-free collapse of a spherically symmetric sphere of gas can be extended to general relativity. (auth) (UK)

35041 PHOTOELECTRIC RADIAL VELOCITIES OF 87 SEVENTH-MAGNITUDE K STARS PREVIOUSLY OBSERVED BY REDMAN. Griffin, R. F. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc.; 148: 211-25(1970).

A photoelectric instrument was used to give very accurate radial velocities for a sample of 87 seventh-magnitude late-type stars. The more recent of two series of measurements yields a standard error of 0.64 km s^{-1} for each observation. Redman (1930, 1932) who observed the same stars photographically 40 years ago, correctly estimated the errors of his observations. In comparison with his work, the photoelectric instrument offers a gain in information rate of about 4000 times. (auth) (UK)

35042 MERIDIONAL CIRCULATION IN ROTATING STELLAR ATMOSPHERES. Smith, R. Connon (Univ. of Sussex, Brighton, Eng.). Mon. Notic. Roy. Astron. Soc.; 148: 275-312 (1970).

Expressions are found for the meridional circulation velocities in the Roche envelope of a uniformly rotating star, using a nonlocal equation for the radiative transfer. It is shown that this use of a nonlocal theory removes the formal singularity at the surface which was found in previous work. However, the circulation speeds near the surface are very great, the resulting shear flow is unstable to the Kelvin–Helmholtz instability, and the flow becomes turbulent. An order-of-magnitude model of the turbulent region is developed, in which turbulent viscosity prevents the flow speeds from becoming too large. The mean speed of the turbulent flow is just subsonic. The effect of the turbulence on the emergent flux of radiation is discussed, and it is shown that the commonly used von Zeipel gravity-darkening law probably remains valid in the presence of turbulence. (auth) (UK)

35043 MODELS OF CLOSE AND CONTACT BINARY STARS. I. POLYTROPIC MODELS. Durney, B. R.; Roxburgh, I. W. (High Altitude Observatory, Boulder, Colo.). Mon. Notic. Roy. Astron. Soc.; 148: 239-47(1970).

Polytropic models of close and contact binary stars were constructed using a combination of perturbation techniques and a Laplace approximation previously applied to uniformly rotating stars. Synchronism between orbital and intrinsic angular velocity was assumed. Models were constructed including the effects of distortion for polytropes with indices n = 1, 1.5, 2, 3, and 4. The conditions for the two stars to be just in contact were determined and contact models with a mass ratio of unity were constructed, right up to the limiting case when the stars fill all the available space inside the critical Roche surface surrounding the two stars. When the two stars are built on the same polytropic model, contact stars with mass ratios different from unity are not possible. (auth) (UK)

35044 COLLISION STRENGTHS FOR TRANSITIONS IN IONS WITH CONFIGURATIONS $3p^3$. Czyzak, S. J.; Kruger, T. K.; Martins, P. de A. P.; Saraph, H. E.; Seaton, M. J. Mon. Notic. Roy. Astron. Soc.; 148: 361-5(1970).

Collision strengths are given for electron-impact transitions between the levels $^4S_{3/2}$, $^2D_{3/2}$, $^2D_{5/2}$, $^2P_{1/2}$, and $^2P_{3/2}$ in ions with configuration $3p^3$. At energies below the threshold for excitation of ^2P the collision strengths are averaged over resonances in series converging onto ^2P. (auth) (UK)

35045 ELECTRON DENSITIES IN PLANETARY NEBULAE. Saraph, H. E.; Seaton, M. J. (University Coll., London). Mon. Notic. Roy. Astron. Soc.; 148: 367-81(1970).

Emissivities are tabulated for lines of [O II] (configuration $2p^3$) and [S II], [Cl III], [Ar IV], and [K V] (configuration $3p^3$), using the most accurate atomic data available. The intensity ratios $R = I(^2D_{5/2} \rightarrow {}^4S)/I(^2D_{3/2} \rightarrow {}^4S)$ are sensitive to electron density. Densities are obtained from observed ratios in eleven planetary nebulae. The results obtained from [O II], [S II], and [Cl III] are in good agreement. Larger densities are obtained from [Ar IV] and [K V] in high excitation planetaries; this may be evidence for large-scale density variations. (auth) (UK)

35046 CRAB NEBULA SYMPOSIUM, JUNE 18–21, 1969, FLAGSTAFF, ARIZONA. Publ. Astron. Soc. Pac.; 82: 875-562(May 1970). (CONF-690639).

Ten papers and a panel discussion are presented from a symposium on the Crab Nebula held at Flagstaff, Arizona on June 18–21, 1969. Separate abstracts were prepared for the ten papers. (W.D.M.)

For abstracts of individual papers see: 35047–35053, and 35086–35088.

35047 OPTICAL STUDIES OF THE CRAB NEBULA: LINE EMISSION COMPONENT. Trimble, Virginia (Smith Coll., Northampton, Mass.). Publ. Astron. Soc. Pac.; 82: 375-87(May 1970).

From Meeting of the Astronomical Society of the Pacific, Flagstaff, Ariz. See CONF-690639.

The proper motions of the central stars and filamentary structures are discussed and the energy input to the Crab is considered. The maintainence of the electron temperature characteristic of the line emission radiation is discussed. (W.D.M.)

35048 OPTICAL CONTINUUM STUDIES. Scargle, Jeffery D. (Univ. of California, Santa Cruz). Publ. Astron. Soc. Pac.; 82: 388-94(May 1970).

From Meeting of the Astronomical Society of the Pacific, Flagstaff, Ariz. See CONF-690639.

A short summary of previously published material on the continuum of the Crab Nebula is given along with a few new points. The spatial distribution, spectral distribution, and polarization of the continuum emission are considered. (W.D.M.)

35049 RADIO OBSERVATIONS OF THE CRAB NEBULA. Drake, Frank (Cornell Univ., Ithaca, N. Y.). Publ. Astron. Soc. Pac.; 82: 395-411(May 1970).

From Meeting of the Astronomical Society of the Pacific, Flagstaff, Ariz. See CONF-690639.

Radio data are presented on the Crab nebulosity, which leads to a figure of 10^{-3} gauss for the magnetic field, as well as some insight into the particle energies, and to the conclusion that the field is dominant in the evolution of the object. Speculations on the nature of the low-frequency compact source at the approximate position of the pulsar are given. (W.D.M.)

35050 X-RAY OBSERVATIONS OF THE CRAB NEBULA. Peterson, Laurence E.; Jacobson, Allan S. (Univ. of California, San Diego). Publ. Astron. Soc. Pac.; 82: 412-30(May 1970).

From Meeting of the Astronomical Society of the Pacific, Flagstaff, Ariz. See CONF-690639.

The results of x-ray observations on the Crab Nebula since 1964 are briefly reviewed. The size of the x-ray-emitting region is about 1.5 minutes-of-arc diameter centered on the amorphous region. The spectral data suggest a power-law continuum between 1 and 500 keV. No polarization or x-ray and gamma-ray line emission was found, although data with more sensitive techniques need to be obtained. Only upper limits to the flux are available above one MeV. Recently, pulsed emission at the same period and phase as that of the radio and optical pulsar has been discovered. (auth)

35051 THE NEBULA: X-RAY DATA. Morrison, P. (Massachusetts Inst. of Tech., Cambridge). Publ. Astron. Soc. Pac.; 82: 431-7(May 1970).

From Meeting of the Astronomical Society of the Pacific, Flagstaff, Ariz. See CONF-690639.

The problems inherent in observing the Crab Nebulae at x-ray wavelengths are briefly discussed, and some speculations on the nature of the x-ray emission are given. (W.D.M.)

35052 SPECTROSCOPIC OPTICAL OBSERVATIONS OF THE CENTRAL STAR. Minkowski, R. (Univ. of California, Berkeley). Publ. Astron. Soc. Pac.; 82: 470-8(May 1970).

From Meeting of the Astronomical Society of the Pacific, Flagstaff, Ariz. See CONF-690639.

The proper motions, distance, and position of the Crab Nebula and the central star are discussed, and it is concluded that the kinematic data do not contradict the now unavoidable conclusion that the south-preceding star is the central star. (W.D.M.)

35053 COMMENTS ON THE VELOCITY AND DISTANCE OF THE CRAB NEBULA. Woltjer, L. (Columbia Univ., N. Y.). Publ. Astron. Soc. Pac.; 82: 479-82(May 1970).

From Meeting of the Astronomical Society of the Pacific, Flagstaff, Ariz. See CONF-690639.

Brief comments are given on the velocity and distance of the Crab and it is concluded that the best value for the distance is 1500 parsecs. A simple method of determining the systematic motion of the nebula is suggested. (W.D.M.)

35054 EXCITATION OF METASTABLE LEVELS IN LOW-DENSITY NEBULAR PLASMAS: [SII] AND [ArIV]. Czyzak, S. J.; Krueger, T. K.; Aller, L. H. (Ohio State Univ., Columbus, Ohio Wesleyan Univ., Delaware, Wright-Patterson Air Force Base, Ohio, Univ. of California, Los Angeles). Proc. Nat. Acad. Sci. U. S.; 66: 282-8(Jun 1970).

Diagnostics of low-density nebular plasma by means of its forbidden-line spectrum require not only a knowledge of certain intensity ratios as a function of its density and temperature but also a knowledge of the occupation numbers of relevant ionic levels. Necessary data for important levels of ionized sulfur and triply ionized argon are presented here. (auth)

35055 SEMICLASSICAL CALCULATIONS OF COLLISIONAL BROADENING OF ION LINES. Roberts, D. E. (Univ. of British Columbia, Vancouver). Astron. Astrophys.; 6: 1-17(May 1970).

Further semi-classical calculations are reported of the collisional ("Stark") broadening of isolated lines emitted by singly charged ions perturbed by electrons and ions. The calculations are relevant to low-temperature (~1 to 3 eV) astrophysical and laboratory plasmas. In order to clarify comparisons with experimental results, several lines were examined for which the elastic cross sections (as determined by the polarization and quadrupole potentials) were expected to be small. Then to obtain a better understanding of the relevant collision processes ab-initio cross sections were calculated for each possible channel (rather than a total cross section). The inelastic cross sections were improved over earlier calculations by accounting for simultaneous coupling between many levels. All the results are expressed in terms of cross sections for different partial waves even though the calculations were done in the classical path limit. These procedures lead to clarification of earlier semiclassical and semi-empirical calculations and allow estimates to be made of the effects of resonant scattering of electrons. Overall it is found that a large proportion of the broadening (up to 50%) can occur from two sources not previously considered, i.e., electron–ion quadrupole excitation and the resonant scattering of electrons. Finally the accuracy of the semiclassical calculations for ion line bradening is estimated to vary from about a factor of two at ~1 eV to approaching 30% at 3 eV. (auth)

35056 THE PLANETARY NEBULAE. XIV. Aller, Lawrence H. (Univ. of California, Los Angeles). Sky Telesc.; 40: 25-7 (Jul 1970).

The evolution of the central stars of planetary nebulae, particularly during the later phases of their lives, is discussed. A model for planetary nebulae containing only the broad outlines of a complete picture is presented. (W.D.M.)

35057 GLOBULAR-CLUSTER STARS. Iben, Icko Jr. Sci. Amer.; 223: No. 1, 27-39(Jul 1970).

The evolution of globular-cluster stars is discussed in detail, and an attempt is made to estimate the helium abundance at the time of formation. The helium abundance is used to make model stars coincide with the relative positions of actual stars in H–R diagrams of clusters, and from this comes an estimate of the age of real clusters to see whether it conflicts with or supports estimates of the age of the Universe derived from other evidence. (W.D.M.)

Quasi-Stellar, Radio, and X-Ray Sources

35058 RADIATIVE OPACITIES AND COMPTON SCATTERING IN STRONG MAGNETIC FIELDS. Canuto, V. (Goddard Space Flight Center, New York). Astrophys. J.; 160: L153-5 (Jun 1970).

The Compton radiative opacity is computed in the presence of a strong magnetic field. It is found that the opacity along the magnetic field is decreased by a factor of $(\omega/\omega H)^2$, where ωH is the cyclotron frequency, for both kinds of circular polarization. For the transverse opacity, half of the intensity is strongly absorbed when the electric field of the wave is parallel to H, while for the other half the opacity is reduced by the same factor of $(\omega/\omega H)^2$. (auth)

35059 SEARCH FOR OPTICAL COUNTERPARTS OF PULSARS CP 0328 AND CP 0950. Cocke, W. J.; Disney, M. J. (Univ. of Arizona, Tucson). Astrophys. J.; 160: L139-42(Jun 1970).

Photoelectric multichannel signal averaging was used to search for pulsed optical components of CP 0328 and CP 0950. Limiting visual magnitudes of 25.5 for CP 0328 and 24.5 for CP 0950 were obtained. (auth)

35060 ANOMALOUS ABSORPTION OF MICROWAVES BY INTERSTELLAR H_2CO. Litvak, M. M. (Massachusetts Inst. of Tech., Cambridge). Astrophys. J.; 160: L133-8(Jun 1970).

It is suggested that gravitationally unstable dust clouds may contain a shock-heated layer where H_2CO molecules are formed. Their infrared emission lines pump the downstream H_2CO to absorb the 2.7°K cosmic background at 6 cm, as observed. (auth)

35061 SEARCH FOR INTERSTELLAR FORMIC ACID AT 1638.806 MHz IN RADIO SOURCES. Cato, M.; Cato, T.; Landgren, P.; Sume, A. (Chalmers Univ. of Tech., Gothenburg, Sweden). Astrophys. J.; 160: L131-2(Jun 1970).

A search for interstellar formic acid in the frequency range of 1.2 MHz led to negative results. (auth)

35062 DETECTION OF THE $^2\Pi_{\frac{1}{2}}$, J = ½ STATE OF INTERSTELLAR OH AT A WAVELENGTH OF 2.2 CENTIMETERS. Turner, B. E. (National Radio Astronomy Observatory, Green Bank, W. Va.); Palmer, Patrick; Zuckerman, B. Astrophys. J.; 160: L125-9(Jun 1970).

The F = 4 → 4 Λ-doublet transition in the $^2\Pi_{\frac{1}{2}}$, J = ½ state of interstellar OH has been detected in the source W3. The other three transitions (F = 4 → 3, 3 → 3, and 3 → 4) were not detected in W3, and none of the four transitions were observed in the eight other sources examined. (auth)

35063 SUPERBRIGHT RADIO "KNOTS" IN THE H II REGION W51. Miley, G. K. (National Radio Astronomy Observatory, Green Bank, W. Va.); Turner, B. E.; Balick, B.; Heiles, Carl. Astrophys. J.; 160: L119-23(Jun 1970).

Fringes were detected from the H II region W51 at a wavelength of 11 cm with an interferometer of lobe separation ~0.6". These observations indicate that the brightness temperature may be in excess of 10^{5}K. Some possible implications of this result are discussed. (auth)

35064 NATURE OF PULSAR RADIATION. Pacini, F. (Cornell Univ., Ithaca, N. Y.); Rees, M. J. Nature (London); 226: 622-4(16 May 1970).

Pulsar radiation may be due to particles that gyrate while moving in bunches along curved orbits. If emitted by electrons, the pulses should come from near the speed of light circle; if emitted by protons, they should arise within a few stellar radii of the underlying star. (auth) (UK)

35065 SHORT-PERIOD PULSATIONS OF THE CP 0808 PULSAR AND THE MAIN CHARACTERISTICS OF ITS RADIO-WAVE EMISSION IN THE METER-WAVELENGTH RANGE. Vitkevich, V. V.; Shitov, Yu. P. (Lebedev Inst. of Physics, Moscow). Dokl. Akad. Nauk SSSR; 191: 553-6(21 Mar 1970). (In Russian).

The cross-shaped radiotelescope at Pushchino was used to study the radio emission of CP 0808 at 60 to 110 MHz. It was found that the pulses consist of 1, 2, or 3 subpulses separated on the average by 53.6 sec. Positions of these subpulses in time indicate that the width of the diagram of the radio emission is directly proportional to the wavelengths within the limits of experimental error. The data also indicated that the so-called second class periodic process with a period of $P_2 = 0.053642 \pm 0.000002$ sec takes place in this pulsar. A regularly repeated fine structure of the subpulse spectrum was also noted. A fairly close quadratic correlation could be established between the delayed time between the subpulses and the wavelength. About 45% of subpulses at the frequency of 86 MHz had a symmetric shape. Some of the pulses appear to be saturated, probably because of the effects of the saturation of the coherent radioemission mechanism. (TTT)

35066 OBSERVATIONS OF HIGH-VELOCITY HYDROGEN CLOUDS AT 21 cm. Meng, S. Y.; Kraus, J. D. (Ohio State Univ., Columbus). Astron. J.; 75: 535-62(Jun 1970).

A 21-cm sky survey of high-velocity neutral hydrogen clouds was conducted with the Ohio State University 260 × 70 ft radio telescope using a 16-channel receiver. Hydrogen clouds were found as follows: four principal groups of clouds, 16 individual clouds and a large, continuous group of clouds of neutral hydrogen with high negative velocities (exceeding −80 km/sec), and seven groups and a few isolated clouds with medium negative velocities (between −40 and −80 km/sec). The results indicate that the high- and medium-velocity clouds seem to be associated. In several cases both appear in the same regions of the sky. Cloud characteristics are tabulated and maps of the clouds are presented. (auth)

35067 DECLINATION AND FLUX DENSITY MEASUREMENTS OF SELECTED 4C SOURCES AT 430 MHz USING THE ARECIBO 1000-FT REFLECTOR. II. Backer, D. C. (Cornell Univ., Ithaca, N. Y.); Hazard, C.; Jauncey, D. L.; Sutton, J. Astron. J.; 75: 529-34(Jun 1970).

Declination and flux density measurements at 430 MHz are presented for 412 sources from the 4C Catalogue. Examination of the error distribution indicates a standard deviation of 25 arc sec for the Arecibo declination measurements. (auth)

35068 AN X-RAY SURVEY OF THE CASSIOPEIA REGION AND ITS IMPLICATIONS CONCERNING SUPERNOVA REMNANTS AND THE GALACTIC SOURCE DISTRIBUTION. Gorenstein, P.; Gursky, H.; Kellogg, E. M.; Giacconi, R. (American Science and Engineering, Inc., Cambridge, Mass.). Astrophys. J.; 160: 947-57(Jun 1970).

An x-ray survey (1 to 10 keV) was made of the Cassiopeia region, $140° \leq l^{II} \leq 160°$, $-15° \leq b^{II} \leq 15$, from a sounding rocket using detectors of high angular resolution. Two sources were observed, and their positions were determined to a precision of about one-tenth of a square degree. The source positions are consistent with those of the supernova remnants Cas A and SN 1572. No other sources with strengths exceeding one-fortieth that of the Crab Nebula were observed. Observations from this flight and two preceding flights suggest that observable x-ray emission comes only from the supernova remnants whose intrinsic diameter at radiofrequencies is relatively small. If sources that can be identified with known supernova remnants are excluded, the Cassiopeia region of the Galaxy appears to be deficient in x-ray sources compared with the center (Sagittarius−Scorpius) and Cygnus. (auth)

35069 ON THE NATURE OF PULSARS. III. ANALYSIS OF OBSERVATIONS. Gunn, J. E.; Ostriker, J. P. (Princeton Univ. Observatory, N. J.). Astrophys. J.; 160: 979-1002(Jun 1970).

Statistical methods are formulated for the analysis of pulsar observations, based upon the magnetic-dipole model presented in the first paper in this series. Applying this formalism to the extant observations, tentative conclusions are reached on the properties of pulsars. These conclusions are discussed in detail. (W.D.M.)

35070 ON THE MOTION OF CURRENT SHEETS, AND THE RADIO, OPTICAL, AND X-RAY EMISSION FROM PULSARS. II. PULSE STRUCTURE, POLARIZATION, TIME-VARYING FEATURES, AND TIGHT-BEAM EMISSION. Lerche, I. (Univ. of Chicago). Astrophys. J.; 160: 1003-17(Jun 1970).

The physical mechanism of an oscillating interface carrying a steady current produces high-frequency radiation, and was proposed in an earlier paper as the generator of pulsar emission. The mechanism is investigated in greater detail in this paper. Simple models of finite-thickness interfaces between the vacuum radiating dipole field and the surrounding ultrarelativistic plasma are used to elucidate various facets of real pulsars. The following is demonstrated: a) The time width and fine structure of the pulses follow from the finite thickness of the interface. b) The polarization "swing" through a pulse, as observed in, say, the Vela pulsar, follow from the expected varying direction of current density in the finite-thickness interface. c) The progressive "march" of individual features through many pulses can be understood on the basis of of a slow drift velocity of regions of high current density through the interface. d) The experimentally determined correlation of long pulse width with slow-period pulsars and of short pulse width with fast-period pulsars is also suggested by the physical mechanism. e) Tight directional beamed emission can be understood in terms of the geometry of the interface around the pulsar. (auth)

35071 FLUX OF CASSIOPEIA A AT 1315 MHz. Encrenaz, P. J.; Penzias, A. A.; Wilson, R. W. (Princeton Univ. Observatory, N. J.). Astrophys. J.; 160: 1185-6(Jun 1970).

The flux of Cas A at 1415 MHz was measured at an average date of 1969.5, and found to be 2369 flux units with a probable error of 60 flux units. (auth)

35072 DYNAMICAL STRUCTURES IN H II REGIONS. Roberts, David Llewellyn. Cleveland; Case Western Reserve Univ. (1968). 67p.

Thesis.

Numerical methods are used to obtain solutions of the equations describing gas motions and radiative transfer in an H II region. That part of the evolution during which dynamical processes become dominant over radiative processes in determining ionization front structure is considered. The gas is heated by the stellar radiation field and cooled by recombinations and radiation in the forbidden lines of oxygen. Two sequences of models are reported: (1) The evolution of an ionization front moving into a constant-density neutral medium is calculated for $\sim 10^5$ years. During this period the ionization front, initially R-type, slows, develops a preceding shock wave, and ultimately follows a high-density neutral shell into the undisturbed medium. The maximum density in the shell is ~100 times that of the undisturbed medium. (2) The encounter of an (initially R-type) ionization front with a region in which the density of neutral matter increases linearly with distance from the exciting star is investigated. A maximum of the square of the electron density in the ionization front is found, which, it is suggested would give such a structure the appearance of a bright rim, as seen in many H II regions. The principal conclusion of this investigation is that cooling processes in the neutral gas dominate the post-shock structure, once the shock and ionization fronts have separated. (Diss. Abstr. Int., B)

35073 ASTROPHYSICAL IMPLICATIONS OF THE CONTINUITY EQUATION PLASMA OSCILLATION. Roth, J. Reece. Nature (London); 226: 626-8(16 May 1970).

There are several periodic astrophysical phenomena that may involve the periodic generation of pulses of charged particles. The

periodicity of pulsars is usually attributed to a dynamical origin, but may instead have a plasma-physical origin. A characteristic feature of the continuity equation oscillation is the periodic production of pulses of ions and electrons from the oscillating region. This oscillation arises from the time delay associated with the transit of charged and neutral particles across the oscillating region, which brings about a relaxation oscillation of the charged-particle number density within it. An appropriate physical model incorporating transit time delays is analyzed and yields the continuity equations $\dot{n} = \bar{n}_e n\,(\sigma v)_{ae} - n_e n\,(\sigma v)_{ee}$, $\dot{n}_e = -\bar{n} n_e\,(\sigma v)_{ae} + n n_e\,(\sigma v)_{ae}$, when n_e and n are, respectively, the time averaged electron and neutral number density in the oscillating region. $(\sigma v)_{ae}$ is the ionization rate parameter for electron–neutral ionization. It is shown that the electron and neutral number densities oscillate with a frequency that is approximately $\nu = \sqrt{n_e n}\,(\sigma v)_{ae}/2\pi$ Hz, when the peak-to-peak amplitude of $n_e(t)$ is small compared with its maximum value. (auth) (UK)

35074 PRECISE DECLINATIONS AND OPTICAL IDENTIFICATION OF SELECTED RADIO SOURCES. Moseley, Gerard Franklin. New Haven; Yale Univ. (1969). 261p.

Thesis.

Methods of measuring accurate declinations with a bandwidth synthesis interferometer are developed; the 245-MHz, 3-km north–south interferometer used for this work had ten 80′ × 17′ beams spaced 8.5′ in declination. Interferometer fringe spacing was 80 arc-seconds, at the zenith, and root mean square fluctuations of the output record were equivalent to 10^{-28} w m^{-2} Hz in a 30-second integration. Observations were made of small angular size extragalactic radio sources, evenly scattered from +54° to −28° in declination, both for the purpose of instrument calibration and for the preparation of a catalogue of precise declinations to assist in optical identification. The accuracy of the new catalogue was verified by comparison with other precise optical and radio positions, as well as with very precise lunar occultation positions and several supersynthesis brightness distributions of extended sources. The resultant declinations had a mean accuracy of two arc-seconds over 75% of the declination range, with four arc-second accuracy at the greatest zenith distances, more than doubling previous precision in half the cases. Using these new declinations, optical identifications are suggested for 18 previously unidentified objects: 11 with blue stellar objects (presumably quasi-stellar) and 7 with galaxies, including one possible 13th magnitude type N galaxy. Three additional new identifications are made of previously misidentified optical objects. (Diss. Abstr. Int., B)

35075 RADIO INTERFEROMETRIC TEST OF THE GENERAL RELATIVISTIC LIGHT BENDING NEAR THE SUN. Muhleman, D. O.; Ekers, R. D.; Fomalont, E. B. (California Inst. of Tech., Pasadena). Phys. Rev. Lett.; 24: 1377–80(15 Jun 1970).

Radio interferometry was used to measure the deflection of a radio source as it passed the Sun. This deflection is a separable combination of refraction in the coronal electron plasma and the general relativistic effect. The observed deflection was $1.04^{+\frac{9}{10}}_{-\frac{11}{10}}$ times that predicted by Einstein's theory of general relativity. The observation also yielded a reasonable value for the coronal electron density. (auth)

35076 MEASUREMENT OF THE DEFLECTION OF 9.602-GHz RADIATION FROM 3C279 IN THE SOLAR GRAVITATIONAL FIELD. Seielstad, G. A.; Sramek, R. A.; Weiler, K. W. (California Inst. of Tech., Pasadena). Phys. Rev. Lett.; 24: 1373–6 (15 Jun 1970).

During its occultation by the Sun in October 1969, the position of the radio source 3C 279 was interferometrically monitored to determine the deviation of its 9.602-GHz radiation in the solar gravitational field. Rapid instrumental calibration and negligible coronal diffraction enabled the measurement of a general relativity deflection of 1.77″ ± 0.20″ at the limb of the Sun. This is the close agreement with Einstein's prediction. (auth)

35077 ANOMALOUS RECOMBINATION LINE 166α. Pedlar, A. (Univ. of Manchester, Jodrell Bank, Eng.). Nature (London); 226: 830–1(30 May 1970).

A spectral line corresponding to the "anomalous" recombination line at 5,011 MHz (109α) recently reported (Palmer et al., Astrophys. J., 156: 887(1969)) was detected at 1,425 MHz(166α) in the H II regions NGC 2024, W3, and possibly W43. The intensity of this line compared with that of hydrogen was found to be much greater than that of the 109α line. The observations described were made in June 1969 using the Mark I 250-ft telescope at Jodrell Bank, in association with the 256-channel autocorrelation spectrometer, and the resulting spectra from NGC 2024, W3, and W43 are shown. It has been suggested that the "anomalous" line is due to carbon. For NGC 2024 and W43 the line does not lie exactly on the frequency of the carbon line, but this could be accounted for by the carbon having a velocity different from the hydrogen. The emission is strongly dependent on the parameters of the H II regions or of the interstellar medium lying in front of the H II regions, but it is not clear what parameters are significant in producing enhancement of the anomalous line relative to hydrogen. The line is not due to an abundance anomaly, and it is improbable that both the hydrogen and the "anomalous" line are emitted from H I regions. It also seems unlikely that dielectronic recombination is the explanation. The observations show that the population of the upper states of the element emitting the "anomalous" line is far from thermodynamic equilibrium, irrespective of whether it is emitted in the same or a different region from the hydrogen. (UK)

35078 PLANETARY COMPANIONS OF PULSARS. Hills, J. G. (Univ. of Michigan, Ann Arbor). Nature (London); 226: 730–1(23 May 1970).

The "quasi-sinusoidal" period variation observed in NP 0532 had been attributed to perturbations produced by a planetary comparison with an orbital period of about 3 months, and it seemed interesting to investigate the orbit of a planet after a supernova explosion of the central star, and the effect of the new orbit on the period of a pulsar. It is assumed that before the explosion the planets were in circular coplanar orbits, and evolution of the new orbit is due chiefly to loss of mass by the central star and not impact of the expanding shell. It is also assumed, for dynamical purposes, that the loss in the original stellar mass is instantaneous; this loss decreases the gravitational energy binding a planet to the central star without affecting its kinetic energy. From these considerations the fractional increase in the semi-major axes of the planets can be calculated; this increase causes the eccentricity to assume a new value. In view of the high frequency of binary stars and their more stringent dissociation requirements compared with planetary systems, it is considered curious that no pulsar with a stellar companion has been observed. It is considered possible that the orbit of the observed planetary companion of NP 0532 may have remained nearly unchanged since the explosion. It may be possible to attribute the apparently abrupt change of period observed in NP 0532 to the perturbations produced by its planetary companion. (UK)

35079 PLASMA TURBULENCE AS A MECHANISM OF PULSAR RADIATION. Ichimaru, S. (Univ. of Illinois, Urbana. Inst. for Advanced Study, Princeton, N. J.). Nature (London); 226: 731–3(23 May 1970).

The characteristics of radio signals from pulsars are summarized, and a pulsar model is presented in which anisotopic plasma turbulence, produced by the onset of a two-stream instability near the light cylinder of a rotating magnetic star is the chief radiation mechanism; the model offers a quantitative and self-consistent explanation of most of the pulsar radiation characteristics, and a qualitative explanation of the other features. The magnetic lines of force passing through the plasma penetrate the light cylinder and may reach the supernova shell or interstellar space. A relativistic electron beam along the magnetic lines of force is assumed such that a typical case of two-stream instability in the plasma is obtained. The plasma will be strongly turbulent, and because of the anisotropy caused by the magnetic field and the streaming electrons enhanced electromagnetic radiation associated with the plasma turbulence will be expected, the power of which is calculated. The level of turbulence is limited only by particle collisions or by the effect of the finite system dimensions, and for plasmas surrounding rotating magnetic stars collisional effects would be expected to play the chief part; the level of turbulence is calculated. There should be quite different turbulent behavior for "fast" as compared with "slow" pulsars. The degree of linear polarization depends on the frequency of observation. Radiation from the anisotropic turbulence due to the two-stream instability has the property of emission in a pencil or fan beam, which appears necessary to explain the pulsations. Parameters are given for NP 0532, PSR 0833, CP 03238, and CP 1919, including comparison of calculations with observations, and Coulomb mean free paths are computed, together with the strength of the magnetic field in the emitting region. A final test of the model will reside in its interpretation of the characteristic difference between "fast" and "slow" pulsars and the frequency dependence of the degree of linear polarization. (UK)

35080 CHARACTERISTIC VARIATION OF SCO X-1. Wilson, R. E.; Twigg, L. W. (Univ. of South Florida, Tampa). Nature (London); 226: 734–5(23 May 1970).

Reference is made to Rao et al. (Nature, 222: 864(1969)) regarding the results of their autocorrelation analysis of the optical photometry of Sco X-1 and the significance of their claim to have shown a periodicity of about 3 hours. It is stated that a

much more profitable approach to the study of the photometry of Sco X-1 is afforded by a simple inspection of the time variation. Supposing that the brightness changes of Sco X-1 are nearly random but that at irregular intervals a characteristic variation appears for, say, a few hours: such a variation would not be periodic and should not lead to significant periodic terms in a power spectral analysis of a long continuous sample, but it could be the signature of a physical process which, although happening at unpredictable times, behaves in a characteristic way each time it occurs. In a restricted data sample such a characteristic variation could mimic a weak periodicity. Attempts were made to look for such a pattern. The findings were not inconsistent with a proposed mechanism in which ionized interstellar matter is guided down magnetic field lines to be accreted on to a neutron star, and as the material is constrained by the field lines to follow a particular flow pattern, a consistent sequence of events may be expected whenever accretion of an interstellar cloudlet occurs. (UK)

35081 ANGULAR SIZE OF THE HIGH-ENERGY X-RAY SOURCE IN THE CRAB NEBULA. Floyd, F. W. (Massachusetts Inst. of Tech., Cambridge). Nature (London); 226: 733-4 (23 May 1970).

New data are reported on the spatial structure of the source of 25- to 100-keV x rays in the Crab Nebula, obtained with a balloon-borne x-ray modulation collimator. The data indicate that this source has an effective angular diameter of at least 1.1 arc minutes. The results are relevant to an understanding of the mechanisms by which the pulsar NP 0532 could give rise to x-ray emission from the Crab, and contradict the suggestion that the Crab is a point source of x rays and that its nebular appearance in the 1.2- to 12-keV range is caused by scattering of the x rays from interstellar grains. If the latter were true the apparent diameter of the source in the 25- to 100-keV range would be less than 0.25 arc minutes because of the rapid decrease of the scattering cross section of dust grains with photon energy. (UK)

35082 SCATTERING OF X RAYS FROM THE CRAB NEBULA. Ryter, C. (CEN, Gif-sur-Yvette, France). Nature (London); 226: 1040-1(13 Jun 1970).

The x-ray source in the Crab appears as a composite system consisting of a diffuse source of diameter about 2 min arc and a pulsating source which is synchronous with the radio and optical pulsar NP 0532, but is has been suggested that the received x rays could in fact all be released from the central star, the apparent extended source arising from scattering of x rays by interstellar dust particles. The typical scattering angle is several minutes of arc for photons of energy a few keV and micron-sized grains. It can be assumed that any x-ray photon received from the Crab was emitted during pulsation, but scattering by an angle as low as 0.1 sec is sufficient to increase the travel time to Earth by more than one pulsar period (0.03 sec), thus hiding the pulsating character of the source, and a typical amount of interstellar dust could explain the low fraction (0.05 to 0.015%) of the power received within the pulsar. Such a model could have important astrophysical implications in the understanding of both the Crab system and the interstellar dust, and the model is discussed in the light of the most recent x-ray observations and the widely accepted picture of interstellar dust (micron-sized grains with an average density of about 1% of the total interstellar material). The problem of x-ray scattering by interstellar dust is discussed in the light of Overbeck's results (Astrophys. J., 141: 864(1965)). It is assumed that the scattering centers are homogeneously distributed in space, that the grains are spherical, and that the distribution of grain size is Gaussian. Comparison of the results with other evidence will show how likely the model is. There is evidence to suggest that the x-ray source had a shape and brightness distribution similar to that of the nebula. The model is found to be faced with two major difficulties—the need for a very high density of interstellar dust and the absence of a strong energy variation of the fractional power received within the pulses. It is concluded that the model cannot be fitted into the accepted framework of interstellar dust theory. Scattering, however, does not effect transmission of the x rays. Observation of pulses from the Crab central star in the 0.6- and 0.25-keV bands would yield valuable information into the nature of interstellar dust. (UK)

35083 HARD X RAYS FROM SCO X-1. Riegler, G. R. (California Inst. of Tech., Pasadena); Bolt, E.; Serlemitsos, P. Nature (London); 226: 1041-3(13 Jun 1970).

Based on the optical and soft x-ray emission, the spectrum of Sco X-1 has been described in terms of bremsstrahlung radiation from a transparent isothermal plasma. During a balloon observation in June 1965, however, evidence was obtained from hard x rays for another spectral component, and a similar feature was observed during a balloon flight on Dec. 15, 1968. The results, and more recent observations show that the hard x-ray component is not compatible with a simple extension of the thermal spectrum at lower energies. The observations reported were made over the band 22 to 60 keV, using a scintillation crystal. The spectrum agreed with a thermal bremsstrahlung spectrum at lower energies, but deviated significantly for harder x rays; the data, however, were insignificant to assign a particular form to the high-energy part of the spectrum. The available data on high-energy x ray emission from Sco X-1 are given. The high-energy excess was not observed in all experiments suggesting large temporal variations, and an interesting feature was the order-of-magnitude difference in the hard x-ray flux observed on Dec. 15, 1966 and May 15, 1967. It is concluded that the spectrum contains at least two major components; the infrared, optical, and soft x-ray emissions can be explained by bremsstrahlung from thermal plasma, but the microwave and hard x radiation cannot originate in the same thermal plasma; and nonthermal electrons could be responsible for hard x-ray bremsstrahlung and microwave synchrotron emission in a way similar to the nonthermal radiation in solar flares. There are, however, significant differences between Sco X-1 and the models for solar flares. (UK)

35084 POSSIBLE PULSAR FORMATION MECHANISM. Wheeler, J. C. (California Inst. of Tech., Pasadena). Nature (London); 226: 1043(13 Jun 1970).

Reference is made to a suggestion that all stars in the interval $3.5M_\odot \lesssim M \lesssim 8M_\odot$ from degenerate C–O cores that converge to the same central conditions before undergoing C ignition. A conclusion that C ignition in such cores will lead to C deterioration, with complete disruption of the star, however, is based on considerations of time-dependent convection. In view of the circumstantial evidence about the parent stars of pulsars and the inherent uncertainties in any theory of convection, it seemed worthwhile to consider an alternative mode of evolution. If convection can prevent C deterioration, the nonviolent C burning in the core will yield a composition predominately composed of O and Mg. The ^{24}Mg may undergo rapid electron capture, which will render the core dynamically unstable and cause it to collapse, and the subsequent behavior of the collapsing degenerate core should be similar to that calculated for collapsing white dwarfs, the oxygen being ignited in the center of the star, with a deterioration wave propagating outwards through the collapsing core. The attendant shock wave should then violently eject the loosely bound H envelope. The core will not explode because of β processes in the matter left in nuclear statistical equilibrium after detonation of the O. The time scale for the pressure to return to its predetonation value is $\lesssim 10^{-3}$ sec due to β processes. Approximately 10^{-2} sec is needed for adiabatic expansion of the core before even the outer layers reach escape velocity, and the core will collapse towards a neutron star state. (UK)

35085 ELECTRODYNAMIC MODEL OF RADIO GALAXIES AND QUASARS. Piddington, J. H. (Commonwealth Scientific and Industrial Research Organization, Sydney). Mon. Notic. Roy. Astron. Soc.; 148: 131-47(1970).

It is shown by statistical and individual studies that the powerful radio sources exhibit increases in magnetic energy and flux by factors $\sim 10^2$ to 10^3 as sources age 10^3 to 10^5 years. This requires a previously developed field system extending >100 kpc along, and twisted around, the rotational axis. The model comprises a rotating gas cloud from which a galaxy condenses, and a pre-existing field which is amplified until the Rayleigh–Taylor instability causes ejection of magnetic tongues along the axis. In an old galaxy the gas has turned to stars (perhaps burnt out), to a corona and to a small central cloud. This cloud, of mass $\sim 10^9$ $M_\odot$, radius $\sim 10^{16}$ cm, field $\sim 10^5$ gauss, rotates rapidly to provide the relativistic particles for the radio and optical synchroton sources. Its thermal plasma provides the QSO line emission. The electrodynamic-gravitational model thus accounts for the complex field system, the acceleration of particles over a period $\sim 10^5$ years, disposal of angular momentum, changes in luminosity, and line emission. Some tests of the model are proposed. In "normal" galaxies the corresponding model is an oblique magnetic rotator which may account for the lower level of radio emission, for the phenomena in Seyfert galaxies and for cosmic rays in general and the primary cosmic rays in the Galaxy in particular. (auth) (UK)

35086 RADIO OBSERVATION OF THE PULSAR NP 0532. Richards, David W. (Arecibo Observatory, Puerto Rico). Publ. Astron. Soc. Pac.; 82: 438-55(May 1970).

From Meeting of the Astronomical Society of the Pacific, Flagstaff, Ariz. See CONF-690639.

The short history of the radio pulsar associated with the Crab Nebula is reviewed. The difficulties involved in detecting this

pulsar are mentioned, and the properties observed to date are discussed. (W.D.M.)

35087 CENTRAL STAR: PHOTOMETRIC OPTICAL OBSERVATIONS. Kristian, Jerome (Carnegie Institution of Washington, D. C. California Inst. of Tech., Pasadena). Publ. Astron. Soc. Pac.; 82: 456-69(May 1970).

From Meeting of the Astronomical Society of the Pacific, Flagstaff, Ariz. See CONF-690639.

The available photometric optical data are reviewed and those facts which are reasonably well established are pointed out. Contradictory and preliminary reports are discussed. (W.D.M.)

35088 REVIEW OF THEORIES OF PULSARS. Chiu, Hong-yee (Goddard Space Flight Center, Greenbelt, Md. State Univ. of New York, Stony Brook). Publ. Astron. Soc. Pac.; 82: 487-533(May 1970).

From Meeting of the Astronomical Society of the Pacific, Flagstaff, Ariz. See CONF-690639.

A discussion, on the basis of observed data and current knowledge of physics, is given on the theoretical status of pulsars. The following topics are considered: geometrical models; collapsed bodies—neutron stars; properties of intense magnetic fields; physical emission mechanisms; magnetospheres of neutron stars; magnetic dipole radiation from neutron stars; pulsating and rotating neutron stars; intense magnetic fields and radio and optical pulses; and future of the pulsar problem. (W.D.M.)

Solar Phenomena

Refer also to abstracts 35232, 35286, and 35320.

35089 (AD-701739) PROPAGATION OF SOLAR PARTICLES TO THE POLAR CAPS. Report for January-June 1969. (Aerospace Corp., El Segundo, Calif.). 15 Dec 1969. 29p. (TR-66(5260-20)-11; SAMSO-TR-70-30). CFSTI.

Measurements of solar particles over the polar caps by satellite-borne experiments are summarized. Solar protons down to about 200-keV energy and solar electrons to about 40-keV energy reach the polar caps. In general, solar electrons illuminate the polar caps uniformly during a solar particle event; in contrast, solar proton fluxes exhibit a great deal of spatial structure. Some diffusion of solar protons across the magnetic field is required in order to account for the experimental results. (auth) (USGRDR)

35090 SEARCH FOR HIGH-ENERGY SOLAR NEUTRONS. Forrest, David John. Durham, N. H.; Univ. of New Hampshire (1969). 165p.

Thesis.

An experiment was performed to search for a flux of solar neutrons at the Earth. The detector used was a large plastic scintillator sensitive to neutrons between 20 and 120 MeV. This detector was carried three different times during 1967 and 1968, by balloon, to an atmospheric depth of ~4g/cm^2. The balloons were normally flown through sunrise and as long as possible into the day. By comparison of the day and night counting rates it was deduced that the upper limit for the continuous emission of solar neutrons at the Earth is less than 2×10^{-2} neutrons/cm^2 sec in the above energy region. If neutrons were emitted in association with any of the fifteen small flares (of optical importance 1F to 2N) that occurred during the flights, then the maximum flux at the Earth was less than 4×10^{-2} neutrons/cm^2 sec. Using a theoretical form these results are expressed as an upper limit differential solar neutron flux at the Earth. The minimum detectable flux with the present instrument is well below the predicted flux from larger flares (e.g., November 12, 1960) of 5 to 50 neutrons/cm^2 sec. (Diss. Abstr.)

35091 MAGNETIC FIELDS ASSOCIATED WITH SUPERGRANULATION. Johnson, Howard Kevin. Rochester, N. Y.; Univ. of Rochester (1969). 119p.

Thesis.

The supergranulation flow alters the configuration of the photospheric magnetic fields in a manner not well understood. Two general aspects of this matter are considered: the supergranulation's role in determining magnetic field fine-structure and the effects of many supergranules on the amplification and dispersion of magnetic fields. The problem is attacked by a method commonly called model building. Several idealized flows are selected to model the observed characteristics of the supergranulation motions. The magnetic field fine-structure in individual supergranules is studied by using flow models that are stationary in time and spatially periodic. These models exhibit significant field growth in the cellular boundary regions where the flow is strongly converging. The calculations predict the occurrence of small clumps of strong magnetic fields in the interstitial regions bordering on several supergranules; recent observations have substantiated these predictions. The effects of many supergranules on the dispersion and amplification of magnetic fields are determined statistically. The supergranulation flow is treated as a given random velocity field so that the statistics of the associated magnetic field can be determined. The use of turbulent diffusion theory verifies the long-time dispersive effect of the supergranulation flow on the mean magnetic field (as suggested by Leighton (1964)). Diffusion of the mean field occurs on the time scale of the solar cycle. Mean square field growth occurs on a much shorter time scale. The small-time mean square field growth is expressed in terms of the functions comprising the velocity correlation. (The velocity correlation function is constructed from the statistical flow model.) The statistical restrictions for finite long-time field growth are discussed briefly. (Diss. Abstr.)

35092 MODEL FOR TYPE III SOLAR RADIO BURSTS. Smith, Dean Francis. Stanford, Calif.; Stanford Univ. (1969). 111p.

Thesis.

Observational data concerning Type III solar radio bursts are reviewed briefly to list the salient requirements of a model for these bursts. The most important of these requirements is that the electron stream exciting these bursts must be stabilized after the energy in plasma waves has reached a highly nonthermal level. Previous theories of Type III bursts are examined to determine the extent to which they meet these requirements. It is submitted that no theory meets enough of these requirements to be acceptable. Results are used to construct a self-consistent model for the emitting region of Type III bursts, assuming a given velocity distribution consistent with observations and using an idealized spectrum of plasma turbulence consistent with the mechanism of stream stabilization. (TSS) (Diss. Abstr.)

35093 PROPERTIES OF THE INTERPLANETARY MEDIUM FROM SCINTILLATIONS IN JOVIAN DECAMETER EMISSION. Pataki, Louis Peter Jr. New Haven; Yale Univ. (1969). 230p.

Thesis.

Observations of the second-long amplitude pulses in Jupiter's decameter radio emission which were recorded at the Yale University Observatory at Bethany, Connecticut and at spaced stations at Pomfret, Connecticut and Huntington, New York at a frequency of 22.2 MHz are presented and discussed. Measurements of the spatial correlation properties of the pulses along three baselines made possible a direct calculation of the correlation properties of the radiation across the observing plane. The source of the amplitude fluctuations is a diffraction phenomenon in the interplanetary medium, and the observations show that the scintillations arise in localized "streams" of enhanced density in the solar wind. While these streams consist of irregularities moving radially outward from the Sun, solar rotation gives them a spiral appearance. The irregularities which make up the diffracting screen are generally elongated. They have a scale of hundreds of kilometers, and move radially from the Sun at velocities of some hundreds of kilometers per second. The excess density in these regions over the mean density of the surrounding solar wind is some tenths of an electron per cubic centimeter; thus, the irregularities form a small modulation of the total density. The properties derived in the present work agree with those derived from observations of other radio sources located at smaller angular separations from the Sun and from spacecraft measurements. The technique of using the Jupiter source as a probe of the interplanetary medium has provided a powerful new tool for the study of interplanetary space. Since Jupiter is at a finite distance from Earth, information is available from a study of its radiation which cannot be obtained from observations of other more distant radio sources. (Diss. Abstr.)

35094 VELOCITY EFFECTS ON THE PROFILES OF Hα AND TWO FeI LINES. Athay, R. G. (High Altitude Observatory Boulder, Colo.). Solar Phys.; 12: 175-85(May 1970).

Profiles are computed for Hα and two Fe I lines for a differentially moving atmosphere. The results show that the profiles are asymmetric and that velocity measurements made in the Doppler cores will often lead to erroneous results when the velocity gradient is significant in the regions of the atmosphere where the core forms. (auth)

35095 LINE FORMATION IN MAGNETIC FIELDS. COMMENTS ON THE ROLE OF ATOMIC LEVEL POLARIZATION. Lamb, F. K. (Oxford Univ.). Solar Phys.; 12: 186-201(May 1970).

Hyder (1968) suggested that longitudinal magnetograph measurements of weak magnetic fields in prominences have underestimated field strengths as the result of zero-field level-crossing interference (the Hanle effect). Hyder (1968) also suggested that

resonance polarization effects have sometimes led to errors in measurements of the transverse component of magnetic fields. Stenflo (1969) has pointed out some errors in Hyder's paper, while contending that the Hanle effect is implicitly included in current theories of line formation in the presence of Zeeman splitting. In this note these questions are re-examined, using the results of a density matrix treatment of absorption, emission, and scattering processes. The basic conclusions are as follows: (1) Longitudinal magnetograph measurements using optically thin lines are not influenced by the Hanle effect. (2) Although present theories of line formation in magnetic fields do not include the Hanle effect, this omission is generally unimportant for lines formed in the photosphere and lower chromosphere due to rapid collisional depolarization of atomic levels. (3) For the same reason, other resonance polarization effects are probably too small to cause significant errors in magnetograph measurements of all but the very weakest magnetic fields, when photospheric and lower chromospheric lines are used. (4) By contrast, the general phenomenon of atomic level polarization is quite important in most prominences. As emphasized by Hyder, extreme care must be used in selecting lines for magnetograph studies of solar magnetic fields. (auth)

35096 FINE STRUCTURE IN Ca II ON THE SOLAR DISC. Pasachoff, Jay M. (Harvard Coll. Observatory, Cambridge, Mass.). Solar Phys.; 12: 202-15 (May 1970).

High-dispersion spectra of the core of the K line of Ca II as seen at the center of the solar disc were reduced. Resolution on the spectra approach 1 arc sec. Line profiles of individual elements are very asymmetric and often are peaked on only one side of the line center. Variations of the line profiles and the emission peaks are discussed. The doubly reversed mean profile of the K line is explained as a spatial average of individual profiles, and it is suggested that single peaks may be caused by Doppler-shifted discrete elements in the chromosphere. (auth)

35097 THERMALLY DRIVEN MOTIONS IN A GRAVITATIONAL ATMOSPHERE. Bessey, R. J.; Kuperus, M. (Astronomical Inst., Utrecht). Solar Phys.; 12: 216-28 (May 1970).

Numerical solutions of the nonlinear equations of fluid dynamics for a compressible inviscid initially isothermal atmosphere are given, using Lax' method for the integration of the equations when discontinuities occur in the flow. The motion of the atmosphere is studied following the heating of a thin layer in the atmosphere. It is found that, for a sufficiently large heat input, the atmosphere strongly expands towards the regions of lower densities. In most cases a shock wave is formed that precedes the expanding region. The possible occurrence of thermally generated motions in the solar chromosphere is discussed. (auth)

35098 EVIDENCE OF TYPE II AND TYPE IV SOLAR RADIO EMISSION FROM A COMMON FLARE-INDUCED SHOCK WAVE. Stewart, R. T.; Sheridan, K. V. (CSIRO, Sydney). Solar Phys.; 12: 229-39 (May 1970).

A solar radio outburst is described in which a moving type IV burst is observed to break up into several components. A close association is found to exist between this source and a type II burst that occurred during the same period, and detailed analysis indicates that both bursts were excited by a common shock wave ejected from the flare region. (auth)

35099 SOLAR CORONAL STREAMERS. I. OBSERVED LOCATIONS, GENERAL EVOLUTION, AND CLASSIFICATION. Bohlin, J. David (High Altitude Observatory, Boulder, Colo.). Solar Phys.; 12: 240-65 (May 1970).

The solar disk locations of 13 coronal streamers were determined from a combination of eclipse, K-coronameter ($1\frac{1}{8} \leq r \leq 1\frac{1}{2}$ R⊙), and balloon-borne coronagraph ($2 < r < 6$ R⊙) observations taken during 1964 and 1965. Of this sample, three were observed twice on photographs taken over intervals of four and 28 days. Most of these streamers could be structurally associated with K-coronameter enhancements to establish their disk locations. Those features having known disk locations all lay above some stage of chromospheric disk activity in the form of active regions and prominences. The average lifetime of three K-coronameter streamer enhancements, for which all or nearly all of their lifetimes were known, was about 4 solar rotations. Rotation rates for the lower-latitude streamer enhancements (≤30°) were essentially identical to the underlying surface. One high-latitude feature (~50°), which overlay a quiescent prominence, had a rate equivalent to the surface rate at 30° latitude. In general, those K-coronameter enhancements associated with streamers came into existence over time periods of ≳ 14 days and disappeared by gradually blending into the background coronal pattern. All the observed structures are explained by a model consisting of localized, high-density features (streamers) that overlie disk activity and are embedded in a uniform but weaker azimuthally symmetric quiet corona. (auth)

35100 THE EMISSION AND PROPAGATION OF ~40 keV SOLAR FLARE ELECTRONS. I. THE RELATIONSHIP OF ~40 keV ELECTRON TO ENERGETIC PROTON AND RELATIVISTIC ELECTRON EMISSION BY THE SUN. Lin, R. P. (Univ. of California, Berkeley). Solar Phys.; 12: 266-303 (May 1970).

Observations of prompt ~40-keV solar-flare electron events by the IMP series of satellites in the period August, 1966 to December, 1967 are tabulated along with prompt energetic solar proton events in the period 1964–1967. The interrelationship of the various types of energetic particle emission by the Sun, including relativistic energy electrons reported by Cline and McDonald (1968) is investigated. Relativistic energy electron emission is found to occur only during proton events. The solar optical, radio, and x-ray emissions associated with these various energetic particle emissions, as well as the propagation characteristics of each particle species, are examined in order to study the particle acceleration and emission mechanisms in a solar flare. Evidence is presented for two separate particle acceleration and/or emission mechanisms, one of which produces ~40-keV electrons and the other of which produces solar proton and possibly relativistic energy electrons. It is found that solar flares can be divided into three categories depending on their energetic particle emission: (1) small flares with no accompanying energetic phenomena either in particles, radio, or x-ray emission; (2) small flares that produce low-energy electrons and that are accompanied by type III and microwave radio bursts and energetic (~20 keV) x-ray bursts; and (3) major solar flare eruptions characterized by energetic solar proton production and type II and IV radio bursts and accompanied by intense microwave and x-ray emission and relativistic-energy electrons. (auth)

35101 ANISOTROPIC SOLAR COSMIC RAY PROPAGATION IN AN INHOMOGENEOUS MEDIUM. II. Burlaga, Leonard F. (Goddard Space Flight Center, Greenbelt, Md.). Solar Phys.; 12: 317-27 (May 1970).

A model for anisotropic solar cosmic-ray propagation is presented that gives two coupled, partial differential equations for the intensity and anisotropy of solar cosmic rays propagating with finite speed V in an inhomogeneous medium. The model is used to study the effect of the solar shell on solar cosmic-ray propagation. It predicts an exponential decay, regardless of the observer's position. It predicts that when the observer is near the center of the shell, $t_D/t_0 \approx 20$ to 30, (t_D = decay time, t_0 = onset time) and A_m (anisotropy) ≈ 15%, if $t_m/t_0 \approx 3$ to 5 (t_m = time of maximum), consistent with observations of relativistic particles on Feb. 23, 1956. When the observer is between the shell and the Sun, the model predicts that oscillations might be observed near maximum intensity. When the observer moves away from the Sun and the shell, the propagation is diffusive, but there is an increasingly large persistent anisotropy which serves as a measure of the width of the shell. (auth)

35102 DETERMINATION OF THE SPREAD FUNCTION FOR SOLAR STRAY LIGHT. Staveland, L. (Univ. of Oslo). Solar Phys.; 12: 328-31 (May 1970).

Parameters of the spread function are obtained by comparing the observed and the computed limb profile and aureole. The limb profile and aureole were studied at nine wavelengths during different seeing conditions. The observations were obtained using the off-axis mirror system at the Oslo Observatory during autumn 1968. (W.D.M.)

35103 LARGE-SCALE GEOMAGNETIC ACTIVITY AND THE DIRECTION OF THE INTERPLANETARY MAGNETIC FIELD. Sievers, LeRoy Edison. Provo, Utah; Bringham Young Univ. (1969). 85p.

Thesis.

Interplanetary magnetic field data obtained from Mariners II, IV, and V during the first two months of each flight were studied to determine relationships between the interplanetary magnetic field direction and large scale geomagnetic activity. High geomagnetic activity is found to occur equally often with north pointing and south pointing fields. Considering data from all three flights, geomagnetic activity appears to be nearly independent of the north–south direction of the interplanetary field. This result implies that proposed mechanisms relating interplanetary parameters to geomagnetic activity which depend on a southward pointing field are not correct. Cross correlation coefficients were computed between geomagnetic indices and interplanetary magnetic field variables in both a geomagnetic dipole coordinate system and a heliocentric equatorial system. The results indicated that no direction in the dipole system is directly related to the mechanism. (Diss. Abstr.)

35104 STUDY OF IONIZED IRON UNDER CORONAL CONDITIONS. CORONAGRAPH OBSERVATIONS OF THE SIX CORONAL IONS OF THE IRON GROUP. Rozelot, J. P. (Observatoire, Pic-du-Midi, France). Astron. Astrophys.; 6: 18-26 (May 1970).

Some newly acquired observations obtained at the Pic-du-Midi Observatory with the 15 cm coronagraph are presented. They cover the end of the most recent solar minimum, as well as the beginning of solar cycle No. XX. The use of a radial slit allows exploratory observations from 1' to 7' from the edge of the photosphere. Spectroscopic analysis of the forbidden lines of Fe X to Fe XV gives results concerning their wavelengths, gradient values in the radial direction or along characteristic lines of fine structure, half-widths, and kinetic temperatures. The disputed case of Fe XII is given special treatment. The reasons for adopting a new value of the wavelength for this line, namely $\Gamma(3p^3\ ^2P_{\frac{1}{2}} - {}^2D_{\frac{3}{2}}) = 33.013\ cm^{-1}$, are explained. An example is given showing the distribution of the six coronal ions of the iron group, obtained with the present equipment. (auth)

35105 RESONANCE AND SATELLITE LINES OF HIGHLY IONIZED IRON IN THE SOLAR SPECTRUM NEAR 1.9 A. Neupert, W. M.; Swartz, M. (Goddard Space Flight Center, Greenbelt, Md.). Astrophys. J.; 160: L189-92(Jun 1970).

A prominent emission feature frequently observed in the solar x-ray spectrum near 1.9 Å at times of chromospheric flares is found, from data obtained by the Fifth Orbiting Solar Observatory, to consist of at least six spectral lines. In addition to the $1^1S_0-2^1P_1$, $1^1S_0-2^3P_1$, and possibly the $1^1S_0-2^3S_1$ transitions of Fe XXV, there appear to be satellite lines originating in highly excited Fe XXIV, Fe XXIII, and lower stages of ionization. (auth)

35106 LIMB DARKENING AND SOLAR ROTATION. II. OBSERVED DARKENING IN 1966. Plaskett, H. H. Mon. Notic. Roy. Astron. Soc.; 148: 149-71(1970).

Spectrophotometric measures of surface brightness at 6263 Å for diametrically opposite limbs of the Sun confirm that the poles are at least 5% brighter than the equatorial limb. Solutions by Radau integration for the source function and computation of photospheric models give temperature as a function of linear height for a number of latitudes. The currents due to the resulting meridional temperature-gradient occur in a photospheric Ekman layer and are of the same order of magnitude as those found from velocities measured at Oxford in 1953 and 1960. These thermal currents are stable and are maintained against viscous loss by heat absorbed in the photosphere. To these currents is probably due the observed decrease of angular velocity towards the poles of the Sun. The origin of polar heating is, however, as yet unknown. (auth) (UK)

35107 SiH $A^2\Delta-X^2\Pi(o,o)$ BAND IN THE FRAUNHOFER SPECTRUM. Lambert, D. L.; Mallia, E. A. (Univ. of Texas, Austin). Mon. Notic. Roy. Astron. Soc.; 148: 313-24(1970).

Low-noise photoelectric scans of the solar disc and sunspot spectra were examined for lines attributable to the (o,o) band of the SiH system $A^2\Delta-X^2\Pi$. Satisfactory identifications were established. A model atmosphere calculation provided a result for the band oscillator strength: $f_{00} = 0.0045$. Isotope shifts were calculated for the less abundant species, ^{29}SiH and ^{30}SiH. It is shown that the isotopic abundances are probably normal. (auth) (UK)

35108 EFFECTS OF PLANETARY TIDES ON THE SUN AND PREVISION OF THE SOLAR ACTIVITY. Dauvillier, Alexandre (Observatoire du Pic du Midi, Bagneres-de-Bigorre, France). Compt. Rend., Ser. B; 270: 1119-21(27Apr 1970). (In French).

The amplitude of the cycle of solar activity between 1910 and 1968 is shown to be proportional to the distance between the center of gravity of the Sun and the center of gravity of the solar system. (France)

35109 CALCULATIONS OF THE RADIATION HAZARD DUE TO EXPOSURE OF SUPERSONIC AIRCRAFT TO SOLAR-FLARE PROTONS. Leimdorfer, M.; Alsmiller, R. G. Jr.; Boughner, R. T. (Oak Ridge National Lab., Tenn.). pp 173-86 of Calcul des Doses de Radiations dans l'Espace. Elbaz, C. (ed.). Toulouse; Comptes Rendus de Journees Europeennes (1968).

From Calculation of Radiation Doses in Space Conference, Toulouse, France. See CONF-680219.

Monte Carlo transport calculations were carried out to estimate the dose received by travelers in supersonic aircraft from a typical spectrum of solar-flare protons. The dose, from both primary protons and secondary particles, as a function of depth in a tissue slab placed at various depths in the atmosphere was obtained. The incident spectrum is broken into eight energy regions, and the dose from the incident protons in each of these regions is presented. (auth)

35110 CONSIDERATIONS RELATIVE TO THE CALCULATION OF RADIATION DOSES IN VIEW OF THE QUANTIFICATION OF BIOLOGICAL EFFECTS IN THE CASE OF SUPERSONIC TRANSPORT. Miro, L.; Pfister, A.; Deltour, G.; Kaiser, R. (CERMA, Paris. DPC-CRN, Strasbourg. CGE, Marcoussis, France). pp 187-94 of Calcul des Doses de Radiations dans l'Espace. Elbaz, C. (ed.). Toulouse; Comptes Rendus de Journees Europeennes (1968). (In French).

From Calculation of Radiation Doses in Space Conference, Toulouse, France. See CONF-680219.

In view of resolving the problem of biological effects of the cosmic ionizing particles as they can be found in the supersonic commercial aircrafts at high-cruising altitudes, it is necessary to take into account certain gaps in our physical (particle characteristics) and biological knowledge and, furthermore, to reconsider the classical notion for radiation doses computation. Following this idea, various balloon experiments were carried out with the help of nuclear emulsions and biological preparations. Results are fragmentary, but it is obvious that a large amount of additional research will still be necessary with close collaboration of teams of physicians and biologists. (auth)

35111 FINE STRUCTURE PROTON EXCITATION RATES FOR POSITIVE IONS IN THE 2p, $2p^5$, 3p, $3p^5$ SERIES. Bely, O.; Faucher, P. (Observatoire, Nice). Astron. Astrophys.; 6: 88-92(May 1970).

Semi-classical collision theory is used to compute cross sections and excitation rates for proton impact excitation of the fine-structure transition in positive ions with the following configurations: 2p, $2p^5$, 3p, and $3p^5$. Fifteen ions are considered in each iso-electronic sequence. Excitation rates are presented in four tables for a wide range of temperatures. (auth)

35112 ABSOLUTE MEASUREMENT OF MEAN LIFETIMES OF EXCITED STATES USING THE METHOD OF CORRELATED PHOTONS IN A CASCADE. Camhy-Val, C.; Dumont, A. M. (Institut d'Astrophysique, Paris). Astron. Astrophys.; 6: 27-50(May 1970). (In French).

The method of correlated photons in a cascade consists in measuring the time interval t_i between the spontaneous emission of two correlated photons of an excited atom in cascading deexcitation, using a time-to-pulse-height converter and a pulse-height analyzer. The time intervals t_i follow the statistical law exp $(-t_i/\tau)$ where τ is the mean lifetime of the intermediate state. The present method was used rather than the pulsed electron beam method because of the cascading effects which may, in this case, involve unravelling several superimposed exponential decays to obtain a lifetime. (W.D.M.)

35113 RESULTS OF SPECIAL OBSERVATIONS FOR THE PROTON FLARE PROJECT 1969. 3. OBSERVATION OF SOLAR RADIO BURSTS BY SATELLITE ALOUETTE II DURING THE PFP INTERVAL, MAY-JULY, 1969. Hakura, Yukio; Nishizaki, Ryo; Tao, Kazuhiko; Yamashita, Fujio (Radio Research Lab., Tokyo). J. Radio Res. Lab., Tokyo; 17: 21-32 (Jan 1970).

A special solar radio patrol was done for the Proton Flare Project (PFP) with a system consisting of satellite Allouette II and ground-based observations. Five hectometric radio bursts of solar origin were observed during May-July, 1969. Dynamic spectra of these bursts were drawn as contour lines of enhanced input signal levels to the topside-sounding receiver. The Type-III solar radio bursts in hectometric wave region in some cases occur without coincident decametric wave bursts, though they are correlated with optical flares that occur in the chromosphere. (auth) (NSA of Japan)

35114 RESULTS OF SPECIAL OBSERVATIONS FOR THE PROTON FLARE PROJECT 1969. 2. SOLAR ACTIVITY DURING THE PFP RETROSPECTIVE INTERVAL, JUNE 5-18, 1969. Takenoshita, Yugoro; Ohbu, Koji (Radio Research Lab., Tokyo). J. Radio Res. Lab., Tokyo; 17: 5-20(Jan 1970).

Solar activity is generally higher in the maximum phase of this solar cycle for the past 19 solar cycles, though it is lower than that of the last one. The Proton Flare Project (PFP) Retrospective Interval 1969 (June 5-18) may be one of the most active periods of this cycle. Geophysical effects were not so severe in contrast to the high solar activity. In the PFP Retrospective Interval, two active regions appeared on the solar disk. In those regions many important flares and outbursts occurred and δ-configuration existed. Flux ratio of the 3-cm solar radio emission and the existence of the δ configuration were very valuable information for good flare forecasts. (auth) (NSA of Japan)

35115 RESULTS OF SPECIAL OBSERVATIONS FOR THE PROTON FLARE PROJECT, 1969. 6. SUMMARY OF JUNE

1969 EVENTS. Hakura, Yukio (Radio Research Lab., Tokyo). J. Radio Res. Lab., Tokyo: 17: 55-68(Jan 1970).

Solar–terrestrial events during the PFP Retrospective Interval June 5–18, 1969 were investigated. Most of the important solar flares and subsequent terrestrial disturbances were attributed to two very active regions, i.e., McMath plage regions 10134 and 10135, that were present on the Sun's visible disk during the interval. The δ-configuration of sunspot magnetic fields appeared in the region 10134 on June 5 and 6, warning of a possible onset of proton-producing flares in the region. Occurrence frequency of x-ray bursts and sudden phase anomalies (SPA's) on several vlf radio waves received at Inubo also predicted the proton flares to occur during the first half of the interval. Actually, two outstanding solar flares of importance 3B occurred at 09:37 and 14:45 U. T. on June 5, being accompanied by giant x-ray and radio bursts. The first flare was overwhelmingly larger than the second one in all aspects of solar–terrestrial relationships. (NSA of Japan)

35116 RESULTS OF SPECIAL OBSERVATIONS FOR THE PROTON FLARE PROJECT, 1969. 4. SPA'S OBSERVED DURING THE PFP INTERVAL. Ohshio, Mitsuo; Nakajima, Toshio; Tsuchiya, Kiyomi; Ishii, Takahiroo (Radio Research Lab., Tokyo). J. Radio Res. Lab., Tokyo: 17: 33-48(Jan 1970).

The occurrence of SPA's observed during May-July 1969 was frequent during the PFP Retrospective Interval 1969 (June 5–18). Their corresponding enhanced maximum solar x-ray (1 to 8 Å) flux intensity was large during the first half of the PFP Retrospective Interval. Several SPA events were discussed in detail, and general demands for analysis of SPA were presented. It may be conjectured that out of many solar x-ray flares which occurred from June 1 until 10, low-energy solar protons would be ejected at the time of flare, having caused solar x-ray flare on June 5, about 10 U.T., from the standpoint of observed SPA's and their corresponding solar x-ray flares. (auth) (NSA of Japan)

Galaxies

Refer also to abstract 33961.

35117 (COO-614-74, Sect. III C) STABILITY OF A DISK GALAXY. Miller, R. H. (Chicago Univ., Ill. Inst. for Computer Research). 14p.

The stability of a self-gravitating configuration of stars is considered in terms of the onset of the instability in a static self-consistent nonuniform configuration. The study was undertaken as part of an attempt to construct a static self-consistent model that might be used as a starting condition for some other investigations. (W.D.M.)

35118 (COO-614-74) ICR QUARTERLY REPORT NUMBER 24. Yngve, Victor H. (Chicago Univ., Ill. Inst. for Computer Research). 1 Feb 1970. Contract AT(11-1)-614. 72p. Dep. CFSTI.

Project support activity is listed. Sections are given on: The memory of skilled actions and the transfer of adaptions in robots; discrimination in information theory; telescope vibrations, stability of a disk galaxy; reducing the rank of $(A - \lambda B)$ using the roots of a generalized characteristic polynomial. A separate abstract was prepared for the section on stability of a disk galaxy. (W.D.M.)

For an abstract of one section see: 35117.

35119 M SUPERGIANTS IN THE PERSEUS ARM. Humphreys, Roberta W. (Univ. of Michigan, Ann Arbor). Astrophys. J.: 160: 1149-59(Jun 1970).

Radial velocities measured from infrared spectra are given for the M supergiants in the Perseus arm. Thirteen M supergiants were confirmed from the MK classification of a number of suspected M super giants. The space distribution and kinematics of these stars agree well with the other Population I objects in the Perseus arm. Seventy percent of the M supergiants are probable members of stellar associations and open clusters. The advantages of infrared spectra for the M supergiants make these stars useful for studies of spiral structure at great distances. A study of the supergiants in Perseus OB1 gives an internal velocity dispersion of 7.2 km sec^{-1}. Evidence for structure in the association is also discussed. (auth)

35120 ROTATIONAL ALIGNMENT OF DISTURBANCES IN THE NUCLEI OF VARIABLE GALAXIES. Clark, Patricia Ann Andre (Univ. of Rochester, N. Y.). Astrophys. J.; 160: 845-57(Jun 1970).

The central regions of variable galaxies (e.g., Seyfert galaxies) characteristically exhibit (1) axially aligned paired structures in the disturbed interstellar medium (jets, filaments, and compact clouds), (2) explosive events, and (3) rapid rotation. Two major problems in the explanation of these observations are (1) the origin of the explosive energy release and (2) the mechanism for the axial alignment. The present work is concerned with the second problem. It is shown that the basic rotation of the galaxy may provide the alignment. The model chosen for the study of the interstellar gas motions in the galactic nuclear region incorporates a gas of uniform temperature in equilibrium in the gravitational field of the massive corotating stellar system. The equilibrium situation is disturbed by a small-scale explosive event which affects only the gas motions. The calculations are presented for the linear response of the gas to an isothermal, spherically symmetric disturbance. It is shown that the rotation, through the action of the Coriolis force, can produce an axially concentrated structure. It is found that the general structure and many of the details of the observations are reproduced even in the solutions of the linear model. The comparison is made specific in terms of the extensive observations of the Seyfert galaxy NGC 1068. (auth)

35121 r-PROCESS PRODUCTION RATIOS OF CHRONOLOGIC IMPORTANCE. Seeger, Philip A. (Los Alamos Scientific Lab., N. Mex.); Schramm, David N. Astrophys. J.; 160: L157-60 (Jun 1970).

Values of the r-process production ratios of galactic chronologic importance were found, taking into account the uncertainties in the mass law as well as other calculation parameters. The values prior to any reactions during freezing out and ejection are: $^{232}Th/^{238}U = 1.96 \pm 0.25$, $^{244}Pu/^{238}U = 0.96 \pm 0.21$, $^{237}Np/^{238}U = 1.89 \pm 0.26$, and $^{235}U/^{238}U = 1.89 \pm 0.36$. (auth)

35122 AXIAL ALIGNMENT OF INTERSTELLAR DISTURBANCES IN NUCLEI OF VARIABLE GALAXIES. Clark, Patricia Ann Andre. Rochester, N. Y.; Univ. of Rochester (1969). 91p.

Thesis.

The central regions of "variable galaxies" (e.g., Seyfert galaxies) characteristically exhibit (1) axially aligned paired structures in the disturbed interstellar medium (jets, filaments, and compact clouds), (2) explosive variability in the light output (changes by factors of two or more over periods of months), and (3) rapid rotation. Two major problems in the explanation of these observations are (1) the origin of the explosive energy release and (2) the mechanism for the axial alignment. This work is concerned with the second of these. It is shown that the basic rotation of the galaxy may provide the alignment. The model chosen for the study of the interstellar gas motions in the galactic nuclear region incorporates the uniform temperature gas in equilibrium with the gravitational field of the massive co-rotating stellar system. The equilibrium situation is disturbed by a small-scale explosive event which affects only the gas motions. The calculation is presented for the linear response of the gas to an isothermal spherically symmetric disturbance. It is shown that the rotation, through the action of the Coriolis force, can produce an axially concentrated structure from the initially spherically symmetric disturbance. It is found that the general structure and many of the details of the observations are reproduced even in the solutions of the linear model. The comparison is made specific in terms of the extensive observations of the Seyfert galaxy NGC 1068. Other relevant observations are also noted. (Diss. Abstr. Int., B)

35123 POSSIBLE INFLUENCE OF THE SPIRAL GALACTIC STRUCTURE ON THE LOCAL DISTRIBUTIONS OF RESIDUAL STELLAR VELOCITIES. Mayor, M. (Geneva Observatory). Astron. Astrophys.: 6: 60-6(May 1970).

The distributions of residual velocities for nearby stars moving in the galactic disk seem to show, independently of their age, a deviation of the vertex for orbits of small eccentricity. This deviation is interpreted not in terms of initial conditions but as a local property of a stellar velocity distribution perturbed by a spiral density wave of the type considered by Lin and Shu. The description of the spiral arms by means of a spiral density wave can also qualitatively account for the decrease of the vertex deviation with the dispersion of the velocities. The difference found between the calculated and observed asymmetrical drift for the objects with little velocity dispersions is explained. For stellar populations having small velocity dispersions and moving in a spiral potential, the nonlinear terms of Liouville's equation can no longer be neglected. The calculation of the nonlinear response of a stellar population to the spiral gravitational field allows to explain the observed anomalies of the plane velocity distributions for stars of small epicyclic energy: deviation of the vertex, "streams". (auth)

35124 SIX-COLOR PHOTOMETRY OF THE NIGHT SKY AT DECLINATION -19° BETWEEN WAVELENGTHS 3900 A AND 7100 A. Dachs, J. (Ruhr Univ., Bochum, Ger.). Astron. Astrophys.: 6: 155-64(May 1970). (In German).

The surface brightness of the night sky at declination −19.2° was measured at six wavelengths ranging from 3920 to 7100 Å, in a circular field of view of 4.5 square degrees with a photoelectric zenith photometer by one-year observations at Tsumeb, South West Africa, from July, 1965, until June, 1966. Mean values for all clear moonless nights of the surface brightness in units of S_{10}, the equivalent number of stars of spectral type A0V and 10th visual magnitude per square degree, are given at intervals of 5 min of right ascension and for wavelengths 3920, 4900, 5580, 5900, 6300, and 7100 Å. (W.D.M.)

35125 PHYSICAL ADSORPTION AND MOLECULAR HYDROGEN DENSITIES OF INTERSTELLAR CLOUDS. Hollenbach, David John. Ithaca, N. Y.; Cornell Univ. (1969). 201p. Thesis.

Three parameters important to the theoretical problem of physical adsorption were studied with special attention given to the cases of light adsorbing gases and low surface temperatures where quantum mechanical effects are important. These parameters are: (i) the sticking coefficient, (ii) the binding energy, (iii) the surface mobility. Particular values of these parameters were calculated and used to determine the rate of hydrogen molecule formation by association of atomic hydrogen adsorbed to interstellar dust grains. It has been suggested that molecule formation on ice surfaces of interstellar grains cannot occur if the grain temperature is above 6°K because evaporation precedes molecule formation. However, the new values of the parameters, coupled with consideration of the effect of impurities and surface defects, show that molecule formation can occur efficiently to grain temperatures as high as 30°K. (TSS) (Diss. Abstr. Int., B)

35126 ON THE DISKS OF SPIRAL AND S0 GALAXIES. Freeman, K. C. (Australian National Univ., Canberra). Astrophys. J.; 160: 811-30(Jun 1970).

Surface photometry shows that most spiral and S0 galaxies have two main components: a spheroidal component, and an exponential disk component with radial surface-brightness distribution $I(R) = I_0 e^{-aR}$. The exponential disk is the subject of this paper. First, for the exponential disk in centrifugal equilibrium with surface density $\mu(R) = \mu_0 e^{-aR}$, the circular-velocity field and the mass–angular momentum distribution M(h) are derived; M(h) is the total mass with angular momentum per unit mass less than h. M(h) for the exponential disk is almost identical with M(h) for a family of ridigly rotating spheres of uniform density. Photometric data for the disks of thrity-six spiral and S0 galaxies were collected, and the following was found; (i) Twenty-eight of the thirty-six galaxies have approximately the same intensity scale I_0 (21.65 B-mag per square second of arc), with a standard deviation of only 0.30 mag per square second of arc, despite a range of nearly 5 mag in absolute magnitude. This constancy of I_0 produces the correlation between apparent magnitude and angular diameter found by Hubble. (ii) S0–Sbc systems have any value of the disk length scale a^{-1} between 1 and 5 kpc, while later-type systems have predominantly low values of a^{-1} (≤2 kpc). (iii) The relative brightness and size of the spheroidal and disk components are only weakly correlated with morphological type. If conclusion (i) implies that μ_0 is approximately constant, then the disk's total mass M and angular momentum H satisfy $H \propto M^{\frac{3}{2}}$. If M(h) is invariant as a protogalaxy collapses to form a galaxy, then all protogalaxies destined to be S0 or spiral galaxies have a similar M(h) (in dimensionless variables), at least for the range of h corresponding to the disk. If M(h) is not invariant, then there exists a very efficient mechanism which establishes the characteristic M(h) for these systems as they form. The exponential nature of the disk is not defined by M(h) alone; its cause remains uncertain. (auth)

35127 THE INTRINSIC FLATTENING OF E, S0, AND SPIRAL GALAXIES AS RELATED TO GALAXY FORMATION AND EVOLUTION. Sandage, Allan; Freeman, Kenneth C.; Stokes, N. R. (Australian National Univ., Canberra). Astrophys. J.; 160: 831-44(Jun 1970).

The distribution of apparent axial ratios for 168 E, 267 S0 + SB0, and 254 ordinary spiral galaxies confirms previous conclusions that ellipticals have only moderate intrinsic flattenings, q, which range from q = 1 to q ≃ 0.3. Ordinary spirals and S0's are intrinsically flatter, possessing thin disks of ⟨q⟩ ≃ 0.25 with only small dispersion. Because of this difference, true spirals and S0 systems cannot have evolved either from, or into, E systems. Evolutionary questions concern (a) why S0 → Im galaxies have flattened to a disk, while E galaxies have not; (b) why the spheroidal components of all galaxies contain only old stars, probably formed at a single epoch; and (c) why S0 and early Sa galaxies have lost their young spiral-arm population, while Sb → Im galaxies have not. Analysis of the four properties, (1) the disk blue-light surface brightness at r = 0, (2) the absolute length scale of the disk, (3) the size ratio of the spheroidal component to the total radius of the galaxy and (4) the mean total mass density ⟨ρ⟩, shows that galaxy type does not depend uniquely on systematic variations of these parameters along the Hubble sequence. The only strongly systematic variable is $\langle\rho\rangle_{tot}$. Observations suggest that the spheroidal subsystem is relaxed. If relaxation occurs by Lynden–Bell's process of a rapidly changing ($\tau_R \simeq$ free-fall time) gravitational potential in the collapsing protogalaxy, then stars in the spheroidal component must be the same age to within the collapse time (several times 10^8 years). Because the mean angular momentum per unit mass, h, of the spheroidal component is low, is is suggested that the relative size of this component is determined by the relative amount of low-h matter in the protogalaxy, and that it is this low-h matter which fragments into stars during the rapid collapse phase; the high-h matter subsequently settles in gaseous form to the disk. The fundamental distinction between E and spiral systems probably lies in their primeval mass–angular momentum distribution. The morphological type of a spiral or S0 system appears to be essentially defined at the time of formation of the old disk stars. (auth)

35128 EMISSION-LINE INTENSITIES AND RADIAL VELOCITIES IN THE INTERACTING GALAXIES NGC 4038–4039. Rubin, Vera C.; Ford, W. Kent Jr.; D'Odorico, Sandro (Carnegie Institution of Washington, D. C.). Astrophys. J.; 160: 801-9(Jun 1970).

Spectrograms of eighteen emission regions in the peculiar extragalactic system NGC 4038–4039 show emission lines of Hβ; [O III] λλ4959, 5007; He I λ5876; [O I] λ6300; [N II] λλ6548, 6583; Hα; and [S II] λλ6717, 6731. The value of the Hα/Hβ intensity ranges from 6 to 14. The helium-to-hydrogen abundance is 0.16 (uncorrected for reddening) or 0.071 (corrected for reddening by using the Hα/Hβ theoretical intensity ratio). From a discussion of the sizes of the luminous regions, the systemic velocity, the magnitude of the brightest stars, and the magnitude of the 1921 supernova, a distance of 9 ± 3 Mpc is estimated. The line-of-sight velocities show a spread of only 235 km sec^{-1} over all the emission regions. The velocity field exhibits a systematic variation from knot to knot, which can be interpreted as due to two rotating, interacting galaxies. (auth)

35129 INTERSTELLAR REDDENING LAW IN THE DIRECTION OF ARA OB1. Honeycutt, R. Kent; Chaldu, Ronald S. (Indiana Univ., Bloomington). Astron. J.; 75: 600-1(Jun 1970).

The wavelength dependence of interstellar absorption was studied for a region of the Southern Milky Way in the constellation Ara using photographic spectrophotometry of objective-prism spectra. The reddening law was found to be similar to the law in Cygnus. (auth)

35130 RADIO OBSERVATIONS OF E AND S0 GALAXIES. Heeschen, D. S. (National Radio Astronomy Observatory, Green Bank, W. Va.). Astron. J.; 75: 523-9(Jun 1970).

Observations were made of 114 of the nearer E, S0, and Sa galaxies, including all those previously known to be radio sources. The observations suggest that there may be a correlation between radio emission and degree of flattening of these galaxies. Radio positions, flux densities at 2-, 6-, and 11-cm wavelengths, and structure at 11-cm wavelength, are given for many of the detected galaxies. (auth)

35131 DIAMONDS AND THE INTERSTELLAR EXTINCTION CURVE. Landau, R. (Univ. of California, Berkeley). Nature (London); 226: 924(6 Jun 1970).

It has been suggested that interstellar extinction might be explained by assuming that interstellar dust is composed of diamond particles of appropirate size distribution, and it is shown that a simple size distribution may be found which can account for the observed extinction. It is noted that small dust grains may be expected to be destroyed by cosmic rays of energy 10 to 100 MeV if the grains are not able to thermalize the energy of the collision. The calculations were made by numerically integrating the extinction cross section over the size distribution of 0.001- to 10-μm radius. The findings, however, do not constitute a strict test for the composition of the dust grains; a simple distribution which fits the extinction observations could probably be found for particles composed of many different materials. (UK)

35132 IS THE DIFFUSE INTERSTELLAR ABSORPTION BAND AT 4430A CAUSED BY TRIVALENT IRON? Manning, P. G. (Dept. of Energy, Mines, and Resources, Ottawa). Nature (London); 226: 829-30(30 May 1970).

It is stated that although the broad, diffuse interstellar absorption bands have been known for many years they still defy identification. It is shown that the wavelength, asymmetry, and half-width of the 4430 Å band are compatible with the values for absorption bands marking the $^6A_1(S) \rightarrow {}^4A_1{}^4E(G)$ transitions in Fe^{3+} in some terrestrial silicates. Garnets were used for comparison, since

their spectra are fairly well understood. It was found that the half-widths of the 4400 Å bands in andradite and schorlomite are 100 Å and 260 Å, respectively, compared with a half-width of 150 to 200 Å for the 4430 Å band in spectra of the supernova SN-NGC-2713. The 4430 Å interstellar band can be highly asymmetric, and this asymmetry can be explained by transitions in Fe^{3+}. It is possible that interstellar grains contain significant concentrations of Fe^{3+}-bearing silicate, and it seems reasonable to suggest that the 4430 Å interstellar absorption band may be due to the $^6A_1 - {}^4A_1{}^4E(G)$ transition in Fe^{3+} ions located in a silicate matrix. (UK)

Cosmology

Refer also to abstract 35230.

35133 INTERGALACTIC CLOUDS. Silk, Joseph (Princeton Univ. Observatory, N. J.). Astrophys. J.; 160: 793-9(Jun 1970).

The intergalactic medium in clusters of galaxies may be thermally unstable. Intergalactic clouds form, at temperatures in the range 2.5×10^4 to $\sim 10^5$ °K. Observational consequences include an interpretation of the multiple absorption redshifts found in the spectra of some quasi-stellar sources. Recent observations of diffuse x rays are used to set limits on the amount of uncondensed intracluster gas. (auth)

35134 RELATIVISTIC GAS SPHERES AND CLUSTERS OF POINT MASSES WITH ARBITRARILY LARGE CENTRAL REDSHIFTS: CAN THEY BE STABLE. Bisnovatyi-Kogan, G. S. (Inst. of Applied Mathematics, Moscow); Thorne, Kip S. Astrophys. J.; 160: 875-85(Jun 1970).

Recently Bisnovatyi-Kogan and Zel'dovich have constructed general-relativistic models of gas spheres and of collisionless star clusters, for which the redshift from the center to infinity is arbitrarily large; and they have speculated that these particular models might be stable against small perturbations. In this paper it is proven that the gas spheres are, indeed, stable—at least against radial perturbations. As for the clusters, it is shown that the most powerful techniques yet devised yield inconclusive results for stability. However, from the behavior of the clusters under scrutiny by those techniques, it is believed that probably they are stable. (auth)

35135 FLUCTUATIONS AND GALAXY FORMATION IN THE EINSTEIN UNIVERSE. Simon, R. (Univ., Liege). Astron. Astrophys.; 6: 151-4(May 1970).

The time evolution of density fluctuations in the Einstein Universe are calculated by means of a classical method due to Landau and Lifshitz, taking into account the self-gravitation of the medium, as has been suggested by Saslaw. The spectrum of these density fluctuations shows a very pronounced peak around the Jeans wavelength and a second maximum that develops in the course of time at a larger wavelength, which is itself increasing. This behavior suggests the formation and the clustering of galaxies, as well as a general recession of the various clusters, i.e., a general expansion of the Universe, and provides therefore a justification of the Eddington–Lemaître model on the basis of the theory of fluctuations. (auth)

35136 RELATIVISTIC, SPHERICALLY SYMMETRIC STAR CLUSTERS. IV. A SUFFICIENT CONDITION FOR INSTABILITY OF ISOTROPIC CLUSTERS AGAINST RADIAL PERTURBATIONS. Fackerell, Edward D. (California Inst. of Tech., Pasadena). Astrophys. J.; 160: 859-74(Jun 1970).

A one-dimensional eigenvalue equation of the Sturm–Liouville type is obtained that optimizes the trial functions used by Ipser in Paper III of this series to analyze the stability against radial perturbations of isotropic, spherically symmetric, relativistic star clusters. This eigenequation provides a very powerful, sufficient criterion for the instability of such a star cluster. Using this criterion, it is shown that a polytropic star cluster of indices $n = 4$ and $\Gamma_4 = 5/4$ is unstable if the redshift of a photon emitted from its center and received at infinity is greater than 0.7302. This result is important because such a cluster has an extreme core–halo density distribution (mean density divided by central density equal to 1.6×10^{-12}), and no previous stability analyses have been capable of handling clusters with extreme core–halo distributions. (auth)

35137 DYNAMICS OF CLUSTERS OF GALAXIES IN UNIVERSES WITH NONZERO COSMOLOGICAL CONSTANT AND THE VIRIAL THEOREM MASS DISCREPANCY. Jackson, J. C. (Univ. of Sussex, Brighton, Eng.). Mon. Notic. Roy. Astron. Soc.; 148: 249-60(1970).

The effects on groups of galaxies of a nonzero cosmological constant are considered. A version of the virial theorem which includes a cosmological term is derived. It is shown that a negative value of λ, in the region -10^{-34} s^{-2} to -10^{-33} s^{-2}, can account quite well for the well-known virial theorem mass discrepancy in actual clusters. The theorem predicts that a graph of log M_{VT}/M against log (cluster mean density) should be a straight line with slope -0.5; the observed value is -0.43 ± 0.08. It is proved that this effect could be responsible for the discrepancy only in universes with curvature index $k = -1$. The Universe ages corresponding to the above range of λ values are calculated; they are shorter than currently accepted values, but, it is argued, not impossible so. (auth) (UK)

35138 DETERMINATION OF THE RADIAL VELOCITY OF RELATIVISTIC STAR. Le Floch, A. C. (College Scientifique Univ., Tours, France). Nature (London); 226: 737-8(23 May 1970).

The value of the radial velocity of a relativistic atom is calculated from the shift of the spectral lines taking into account the transverse velocity, using the special theory or relativity, and the method is applied to the spectra emitted by the atoms of moving stars. Amongst conclusions reached are that the value of the radial velocity of a moving star cannot be calculated if only the Doppler shift is known, unless the star is not relativistic or its transverse velocity is negligible compared with its radial velocity; also that redshift alone cannot be a proof of expansion of the Universe when considering the redshift of the spectral lines of extragalactic nebulae. (UK)

Planetary Phenomena

35139 GAMMA-RAY SPECTROSCOPIC MEASUREMENTS OF MARS. Metzger, A. E. (California Inst. of Tech., Pasadena); Arnold, J. R. Appl. Opt.; 9: 1289-1303(Jun 1970).

A gamma ray spectrometer placed in orbit around Mars is expected to yield significant compositional data that can be related to the evolution of that planet. Components of the observable gamma ray flux come from the Martian surface, galactic and intergalactic space, and the spacecraft itself. The flux can be detected by a scintillation crystal or solid-state detector, either of which combines efficiency of detection with energy resolution, and returns information to the Earth as a pulse-height distribution in order to detect characteristic energy-line structure. The data will be evaluated for evidence of elemental differentiation with reference to terrestrial, meteoritic, solar, and lunar abundances. A lengthy mission will allow the surface of Mars to be mapped in a search for possible correlations between composition and topography or albedo. (auth)

35140 JOVIAN DECIMETER RADIATION. Wilkinson, J. E. (Queensland Inst. of Tech. Capricornia, Rockhampton, Australia). Aust. J. Phys.; 23: 197-202(Apr 1970).

The drift in longitude of electrons in Jupiter's magnetic field is considered. The characteristic time of synchroton radiation yields a magnetic flux density of some 30 G at the equator of Jupiter. (Australia)

35141 APOLLO 11 EVIDENCE FOR THE DIFFERENTIATION OF LUNAR MATERIALS. Mueller, R. F. (Goddard Space Flight Center, Greenbelt, Md.). Nature (London); 226: 925-7(6 Jun 1970).

Although many controversies exist regarding the problems of the origin of the Moon, it is reasonable to start with the assumption that it was originally formed from a cloud of gas and dust approximating solar or cosmic composition and that differentiation occurred with regard to certain gases and more refractory elements. Possible processes of differentiation are discussed. The chemical composition of the rocks must be considered in relation to the history of the entire surface, and the surface features are due chiefly to impact explosions varying in kinetic energy. It follows that the lunar deposits have been strewn and restrewn across the surface and disturbed to depths of the order of many kilometers. The extent to which igneous and other processes have modified the process of lateral and vertical mixing in unknown, but is subject to test by chemical analysis such as is discussed in this communication. A useful parameter for correlating geochemical data is the first ionization potentials of elements, and this parameter enters directly into the theory of ambipolar diffusion and should be directly related to possible differentiation in the pre-planetary nebular gas. Perhaps the most significant feature of the chemical analysis is the great similarity of composition of all the rocks from Tranquility Base. Another important feature is the qualitative similarity between the distribution patterns of the lunar rocks and the Earth's crust. The evidence, however, indicates that lunar materials have undergone some differentiation amongst the refractory elements. The fact that the rocks from Tranquility Base are denser than the mean den-

sity of the Moon indicates a differentiation process by which Fe is preferentially concentrated in the outer layers. In terrestrial differentiated complexes analogous to the lunar rocks Fe is highly concentrated in the melt relative to Mg as crystallization proceeds, and Apollo 11 data point to a similar relation for the rocks at Tranquility Base. Implications of the relative low water content of the lunar rocks are discussed. The concentration of the TiO_2 is also discussed. It is concluded that the compositions of the surface rock at Tranquility Base appear to be consistent with a differentiation mechanism, perhaps of a complex character embodying igneous and other processes, but which was probably concerned with elements similar to those which produced the Earth's crust. There are, however, important modifications due to be low water content of the lunar rocks. (UK)

35142 RUNAWAY GREENHOUSE AND THE ACCUMULATION OF CO_2 IN THE VENUS ATMOSPHERE. Rasool, S. I.; de Bergh, C. (Goddard Space Flight Center, New York). Nature (London); 226: 1037-9(13 Jun 1970).

An outline is given of the probable evolution of the atmosphere of Venus and comparisons are made with the Earth. The atmosphere of Venus is composed largely of CO_2 and appears to be deficient in water compared with the Earth. It is considered that the chief differences can be explained by the fact that Venus was formed much closer to the Sun; if the Earth had been formed only 6 to 10 million km nearer the Sun, it might also have become a hot and sterile planet. The amount of CO_2 in the atmosphere of Venus is approximately equal to the amount existing in the Earth's crust in the form of carbonates. In an attempt to trace the evolutionary history of Venus the following basic assumptions are made regarding its atmosphere: (1) at some time in the early history of the solar system the terrestrial planets completely lost their primordial atmospheres; (2) the present atmospheres have developed mainly from degassing of the planetary interiors (except for free O_2 in the Earth's atmosphere); (3) the chief outgassing constituents were water vapor and CO_2. Before outgassing, when the planets were more or less devoid of an atmosphere, their ground temperatures were essentially determined by the amount of solar radiation absorbed by the surface; as the atmosphere accumulated, however, the ground temperature increased due to additional heating by the atmospheric "greenhouse" effect. The magnitude of the effect can be calculated by solving the equation of radioactive transfer for a given atmosphere, but the problem is complicated by the strong frequency dependence of the infrared molecular absorption coefficient, particularly for water vapor. To a first approximation a grey atmosphere is assumed, and the Eddington approximation used for solution of the radioactive transfer equation. The "greenhouse" calculations for Venus are started at time zero, when the outgassing had just begun and the total amount of atmosphere was $<10^{-3}$ m bar. As the atmosphere accumulated, the "greenhouse" effect increased the ground temperature, and since the surface temperature was quite high, H_2O remained in the atmosphere and accelerated the "greenhouse" effect. The high surface temperature and the complete absence of liquid water from the surface has a significant bearing on the accumulation of CO_2. Furthermore, at high temperatures, large quantities of CO_2 could accumulate in equilibrium with silicates, and CO_2 continued to accumulate in the atmosphere to the present value of ~75 atm at 700°K. Some discussion is also included on conditions on Mars. (UK)

35143 MEASUREMENTS OF LUNAR RADIATION IN THE WAVELENGTH RANGE CENTERED AT 1.2 mm. Clegg, P. E.; Carter, B. S. Mon. Notic. Roy. Astron. Soc.; 148: 261-74(1970).

The results of several investigations of the lunar surface thermal properties are reported including observational and theoretical considerations of the effect of roughness on the polarization of this radiation. It is concluded that roughness plays an important part in determining the millimeter wavelength thermal emission of the Moon. In particular the difference in temperature between Moon and highlands and the observed poleward darkening function may be attributed to roughness. An effective dielectric constant for the surface material is deduced and a tentative model for the centimeter scale roughness of the surface advanced. It appears that roughness increases as the scale on which it is observed decreases. (auth) (UK)

35144 SYMPOSIUM ON PLANETARY ATMOSPHERES AND SURFACES, WOODS HOLE, MASSACHUSETTS, AUGUST 11–15, 1969. Bowhill, Sidney A. (ed.). Radio Sci.; 5: 121-533(Feb 1970). (CONF-690835).

Separate abstracts were prepared for six of the forty-four papers. (W.D.M.)

For abstracts of individual papers see: 35145–35149, and 35292.

35145 TWELVE-YEAR PERIODICITIES OF THE DECAMETRIC RADIATION OF JUPITER. Carr, Thomas D.; Smith, Alex G.; Donivan, Frank F.; Register, Henry I. (Univ. of Florida, Gainesville). Radio Sci.; 5: 495-503(Feb 1970).

From Symposium on Planetary Atmospheres and Surfaces, Woods Hole, Mass. See CONF-690835.

Three parameters of Jupiter's decametric radiation which apparently undergo cyclic variations with periods of the order of a decade are the mean occurrence probability for an apparition, the central meridian longitude of the main source, and the effective width of the main source (or Source A). Observational results indicate that the oscillation in each parameter is caused by the apparent change in Jupiter's aspect as it orbits the Sun and that the period in each case is therefore 11.86 yr. It was found that the average rotation period over an 11.86 year interval is 9h 55m 29.73s ± 0.04s. This is probably the rotation period of Jupiter's magnetic field. (auth)

35146 LUNAR OCCULTATION OBSERVATIONS OF JUPITER AT 74 CM AND 128 CM. Gulkis, Samuel (California Inst. of Tech., Pasadena). Radio Sci.; 5: 505-11(Feb 1970).

From Symposium on Planetary Atmospheres and Surfaces, Woods Hole, Mass. See CONF-690835.

An immersion occultation of Jupiter by the Moon on October 19, 1968, UT was recorded at wavelengths of 128 cm (234 MHz) and 74 cm (405 MHz) with the 140-foot radio telescope at Green Bank, West Virginia. One-dimensional brightness distributions are derived from the occultation curves. They show a small asymmetry in the structure of the belts. The results are combined with observations made at shorter wavelengths to show that there is a significant increase in the angular size of the emission at the longer wavelengths and that the relativistic electron energy spectrum must have a narrow range of energies close to the planet (~1.5 R_J). The importance of the variation of the magnetic field strength on the radiation emitted from an esemble of electrons trapped in a dipole field is discussed. (auth)

35147 LONG-TERM VARIATIONS OF THE DECIMETER RADIATION OF JUPITER. Gerard, Eric (Nancay Radio Observatory, France). Radio Sci.; 5: 513-16(Feb 1970).

From Symposium on Planetary Atmospheres and Surfaces, Woods Hole, Mass. See CONF-690835.

The total flux density of Jupiter was measured from December 1967 to August 1968 and was found to vary. There is good evidence for a positive correlation with solar activity as measured by the 10.7-cm flux; the most probable phase lag lies between 3 and 9 days. (auth)

35148 MICROWAVE SPECTRUM OF JUPITER. Dickel, John R.; Degioanni, Joseph J.; Goodman, Gary C. (Univ. of Illinois, Urbana). Radio Sci.; 5: 517-27(Feb 1970).

From Symposium on Planetary Atmospheres and Surfaces, Woods Hole, Mass. See CONF-690835.

New polarimetric observations of Jupiter at 15.4 and 6.65 GHz were combined with previously published values to determine the microwave spectrum of the planet. All of the data were normalized to a consistent scale that should be good to 7% on a relative and, hopefully, on an absolute scale. The compound emission was then separated into its thermal and polarized nonthermal components. The results showed that a considerable range of models for the atmosphere of Jupiter will match the spectrum of the thermal component. The most reasonable model probably has an effective temperature near 130°K. The nonthermal synchrotron emission from the Van Allen belts of Jupiter has a peak in its spectrum near 800 MHz and a discontinuity at higher frequencies that suggests two radiation belts surrounding the planet. The polarized fraction of this synchrotron emission reaches a peak of about 30% near a frequency of 3000 MHz but drops on either side of this frequency. (auth)

35149 SYNCHROTRON MODEL FOR THE DECIMETRIC RADIATION OF JUPITER. Clarke, J. N. (Univ. of Toronto, Richmond Hill, Ont.). Radio Sci.; 5: 529-33(Feb 1970).

From Symposium on Planetary Atmospheres and Surfaces, Woods Hole, Mass. See CONF-690835.

The two-dimensional distribution of intensity and polarization was calculated for the synchrotron radiation from electrons trapped in a dipolar field around a planet. From formulas recently published by Legg and Westfold, the circular polarization was included. The integrated data from these maps were used to suggest models with two thick belts of electrons to account for the decimetric radiation from Jupiter. (auth)

Atomic and Molecular Physics

Refer also to abstract 33976.

Atomic, Electron, Ion, and Molecular Beams and Their Reactions

Refer also to abstracts 35371 and 35571.

35150 MOST PROBABLE ENERGY LOSS AND STRAGGLING OF 28-MeV ELECTRONS. Davies, G. R.; Jennings, R. E. (Norwood Technical Coll., London. University Coll., London). J. Phys., B (London); 3: 804-12(Jun 1970).

Measurements were made of the most probable energy loss and straggling of 28-MeV electrons in passing through foils of tungsten of different thicknesses (up to about 2 g cm^{-2}) and also through an aluminium foil. For the tungsten foils the experimentally measured values for the most probable energy loss are in very good agreement with the theoretical predictions. Good agreement is also obtained for the variation of the widths at half height of the straggling distributions with the Blunck–Westphal (1951) theory up to thicknesses of about 1 g cm^{-2}. For larger thicknesses the distributions are found to be slightly narrower than expected theoretically. The measurements using a single thickness of aluminium foil were made for comparison purposes (i.e., between elements of high and low atomic number). In this case the half-width was found to be slightly wider than predicted by theory. (auth) (UK)

35151 X-RAY ATTENUATION CROSS SECTIONS OF AIR BETWEEN 0.1 keV AND 1 MeV. Veigele, Wm. J. (Kaman Nuclear, Colorado Springs, Colo.). J. Appl. Phys.; 41: 3178-81(Jun 1970).

X-ray attenuation cross sections for air were synthesized from values for N, O, and Ar taken from a previously made compilation of experimental data. Weight fractions of 0.755, 0.232, and 0.0128 were used for N, O, and Ar, respectively; all other constituents were neglected. The cross sections are presented in a table that shows also experimental values and values from other compilations. (A.G.W.)

35152 COMPARISONS OF THE REFLECTION AND DIFFRACTION OF ^3He, ^4He, H_2, AND D_2 FROM THE (001) SURFACE OF LiF. O'Keefe, D. R.; Smith, Joe N. Jr.; Palmer, R. L.; Saltsburg, Howard (Gulf General Atomic Inc., San Diego, Calif.). J. Chem. Phys.; 52: 4447-58(1 May 1970).

Comparisons of the reflection and diffraction of thermal-energy beams of ^3He, ^4He, H_2, and D_2 from the (001) surface of LiF are reported. Intense diffracted beams, including those of the second order, result from a freshly cleaved LiF surface without heating, and large exposures of H_2O vapor do not reveal any measurable change in either the intensity, normalized to constant incident beam intensity, or location of such beams. The intensity and location of the individual beams are examined, taking into account the influence of adjacent beams. The locations of beams not so influenced display good agreement with the predictions of simple diffraction theory. The shapes and intensities of the diffracted beams are compared for the four gases with reference to possible inelastic effects. The decreasing intensities of diffracted beams for the same incident de Broglie wavelength are found to be in the order ^4He, H_2, and D_2, i.e., in the order of increasing rotational energy coupling with the surface; ^3He diffracted beams have intensities approximately the same as for ^4He. The order of decreasing specular intensity, on the other hand, changes, depending on angle of incidence, but ^3He is consistently more intense than for ^4He, implying a mass collisional dependence. Preferentially scattered beams, similar to those reported for the heavier rare gases, are also evident although the presence of these beams only becomes apparent when conditions are such that the influence of other beams (diffracted and specular) is small. Selective adsorption studies reveal the presence of one or more bound energy states for each of the gases. The energy states for ^3He and ^4He are found to be significantly different, which is consistent with the results for the adsorption of these gases on charcoal. The energy states for H_2 and D_2 are identical, within the experimental error, and considerably greater in magnitude than for either ^3He or ^4He. (auth)

35153 SURFACE AND VACUUM PHYSICS INDEX. VOLUME 5, NO. 4, 1970. Bibliography, Author Index, Subject Index in Alphabetical Order, Cumulative Subject Index in Logical Order. Frankfurt am Main; Zentralstelle fuer Atomkernenergie-Dokumentation (1970). 70p.

This listing includes 293 references. (L.M.T.)

35154 SURFACE AND VACUUM PHYSICS INDEX. VOLUME 5, NO. 3, 1970. Bibliography, Author Index, Subject Index in Alphabetical Order, Cumulative Subject Index in Logical Order. Frankfurt am Main; Zentralstelle fuer Atomkernenergie-Dokumentation (1970). 53p.

This listing includes 220 references. (L.M.T.)

35155 CHARACTERISTIC ELECTRON ENERGY LOSSES IN Y, Zr, Nb, AND Mo. Zashkvara, V. V.; Korsunskii, M. I.; Red'kin, V. S.; Masyagin, V. E. (Inst. of Nuclear Physics, Alma-Ata, USSR). Sov. Phys.-Solid State (Engl. Transl.); 11: 3083-4(Jun 1970).

Translated from Fiz. Tverd. Tela; 11: 3667-9(Dec 1969).

Characteristic energy-loss spectra were measured for Y, Zr, Nb, and Mo for two different scattering angles of the 1-keV electron beam, 39° and 141°. The 141° spectra are in good agreement with literature values obtained for 90°. The first peak position does not change for 39° and 141°, while the second peak, due to bulk plasma oscillations, shifts toward lower energies by 2 or 3 eV when the angle is shifted from 141° to 39°. (D.L.C.)

35156 ENERGY-LOSS SPECTRUM OF FAST ELECTRONS IN A DIELECTRIC SLAB. I. NONRETARDED LOSSES AND CHERENKOV BULK LOSS. Lucas, A. A.; Kartheuser, E. (Univ., Liege). Phys. Rev., B; 1: 3588-98(1 May 1970).

The energy lost, in the phonon-energy range, by a fast electron beam passing through a polar dielectric slab is analyzed using classical electrodynamics. The medium is represented by a frequency-dependent dielectric constant $\epsilon(\omega) = \epsilon_\infty (\omega_L^2 - \omega^2)/(\omega_T^2 - \omega^2)$ having one single pole at the transverse optical-phonon frequency ω_T and one zero at the longitudinal-mode frequency ω_L. When retardation effects are excluded ($c = \infty$), two kinds of losses occur: bulk losses resulting from the emission of the longitudinal optical phonon at ω_L and surface losses due to the excitation of "surface" vibrations whose frequencies lie within the gap (ω_T, ω_L). Both effects can be obtained exactly in terms of closed analytic functions of ω. When retardation is taken into account, radiation losses take place as well, either through Cherenkov radiation in the bulk of the slab or through the so-called "transition radiation" occurring at the surfaces of the slab. Only the Cherenkov loss is studied. (Surface radiative losses are treated in part II.) Comparison with experimental results for alkali–halide crystals and with calculations due to Fujiwara and Ohtaka is presented. (auth)

35157 TOTAL CROSS-SECTION CALCULATION OF Li ATOM IONIZATION BY SLOW ELECTRONS. Liepinsh, A. K. (Inst. of Physics, Riga). Latv. PSR Zinat. Akad. Vestis, Fiz. Teh. Zinat. Ser.; No. 2, 3-7(1970). (In Russian).

Incident-wave distortion for Li atoms is taken into account when calculating the total cross sections. The estimation of corrections to the total cross section for ionization are given in Born's approximation. It is concluded that the sum of partial ionization cross sections converge slowly; therefore it is wrong to consider the sum of several partial cross sections to be the essence of the total cross section. (auth)

35158 MECHANISM OF EXOELECTRON EMISSION AFTER EXCITATION WITH ELECTRONS. Drenckhan, J.; Gross, H.; Glaefeke, H. (Univ., Rostock, Ger.). Phys. Status Solidi (a); 2: K51-4(16 May 1970).

A model is proposed for exoelectron emission by insulating materials bombarded by electrons. The surface is charged positively, the primary electrons penetrate to a certain depth and are captured by traps, and a negative space-charge region is built up. The trapped electrons are thermally released into the conduction band and then accelerated to the surface by the internal electric field. Field strength and retarding-potential curves were measured experimentally for SiO_2 to confirm the model. The compensation effect of 2-eV electron on the surface positive charge following 1.5-keV electron excitation was also measured. (D.L.C.)

35159 ANGULAR DISTRIBUTION OF SECONDARY ELECTRONS FROM ION BOMBARDMENTS. Losch, W. H. P. (Univ., Munich). Phys. Status Solidi (a); 2: 123-9(16 May 1970). (In German).

The angular distribution of secondary electrons induced by perpendicular bombardment with H_1^+, H_2^+, and H_3^+ ions ($0.1 \leq E_i \leq 5$ keV) on polycrystalline W, Al, Mo, and (100) Al single-crystal surfaces was investigated. On metallically clean surfaces of polycrystalline materials, a cosine distribution is found. On the single crystal along ⟨100⟩ and ⟨110⟩ directions ($\vartheta = 0°$ and 45°, respectively), a smooth club-shaped distribution is found superimposed by a fine structure along the direction $\vartheta = 20°$. Surface impurities cause anisotropic electron emission, in that electrons are preferentially emitted along concentric cones with certain apex angles. The maxima of the angular distributions are independent of the material, the type of ion, and the direction ϑ; the faster the emitted electrons, the more distinct these maxima become. Further, for Mo, the dependence of the energy distribution on the angle of emission is investigated, and the secondary emission factor γ for Al and Mo is determined. (auth)

35160 PARAMETERS OF ENERGY SPECTRA OF EXOELECTRONS FROM METAL SURFACES. Kortov, V. S.; Mints, R. I.;

Myasnikov, I. E.; Shevchenko, Yu. A. (Kirov Institut, Sverdlovsk, USSR). Phys. Status Solidi (a); 2: 55-9(16 May 1970). (In German).

An exoelectron spectrometer is described using a multichannel amplitude analyzer. The measurement of exoelectron energy is performed in vacuum by means of scanning with a retarding potential. The energy spectrum parameters of exoelectrons were obtained from the Al, Ti, and W surfaces after polishing. The presence of a certain amount of electrons whose energy exceeds the photoelectron energy was revealed. All results obtained prove the fact that exoemission may not be explained merely by a deformation-induced photoeffect. (auth)

35161 MULTIPLE SCATTERING OF PROTONS IN POLYSTYRENE. Galishev, V. S. Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 4, 141-2(1969). (In Russian).

A modification of the theory of Reed and Nodvik (Phys. Rev., 135B: 199-202(1964)) was used to calculate the angular distribution of protons multiply scattered in polystyrene. Calculations were made for proton energies of 106 to 218 keV and polystyrene thicknesses of 24, 40, 69, 88, and 104 $\mu g/cm^2$. Results are compared with the experimental data of Bednyakov, et al. (Zh. Eksp. Teor. Fiz., 42: 740(1962)). Good agreement was obtained for the two thicker films at all energies and for the 69-$\mu g/cm^2$ film at lower energies. For the thinner films the theoretical values were larger than the experimental values. (A.G.W.)

Atomic and Molecular Properties

Refer also to abstracts 35044, 35054, 35055, 35112, 35411, 35416, 35417, 35675, and 35699.

35162 (LA-4402) CALCULATION OF ATOMIC-ENERGY-LEVEL VALUES. Radziemski, Leon J. Jr.; Fisher, Kay J.; Steinhaus, David W. (Los Alamos Scientific Lab., N. Mex.). Feb 1970. Contract W-7405-eng-36. 79p. Dep. CFSTI.

Two methods for solving the least-squares formulation of the atomic-energy-level calculation problem were coded. The matrix-inversion method is capable of handling a 285-by-1000 level array with up to 19,000 classifications. An important advantage of this method is that the complete variance-covariance matrix is calculated, which leads to the correct computation of calculated wave-number uncertainties. The iterative method is presently capable of accepting a 1000-by-1000 level array with 20,000 transitions. It is inherently capable of computing the least-squares answers to even larger arrays, but has the disadvantage that the variance-covariance matrix cannot be easily calculated. The Gauss-Seidel iterative method as applied to the level calculation problem is demonstrated to be a convergent iterative process. (auth)

35163 TABLITSY SPEKTRAL'NYKH LINII NEITRAL'NYKH I IONIZOVANNYKH ATOMOV (H, He, Li, C, N, O, F, Ne, Na, Mg, Al, Si, Cl, Ar, K, Ca, Ti, Fe, Cu, Kr, Xe, Cs). (Tables of Spectral Lines of Neutral and Ionized Atoms (H, He, Li, C, N, O, F, Ne, Na, Mg, Al, Si, Cl, Ar, K, Ca, Ti, Fe, Cu, Kr, Xe, Cs)). Striganov, A. R.; Sventitskii, N. S. Moscow; Atomizdat (1966). 900p.

Tables of the spectral lines of neutral and ionized atoms of 22 elements are presented. All gases, the alkali metals, and certain other common metals are included. The tables cover all of the optical spectrum from infrared to vacuum ultraviolet. For each line, the classification and the energies of the upper and lower levels are given. The tables are more nearly complete than previously published tables. The book is intended for physicists and engineers interested in plasma investigation. It should also be helpful to workers in the field of atomic spectroscopy. (tr-auth)

35164 NONADDITIVE MULTIPOLAR INTERACTION OF THREE HYDROGEN ATOMS. Bell, R. J. (National Physical Lab., Teddington, Eng.). J. Phys., B (London); 3: L63-6(Jun 1970).

The nonadditive third-order interaction energy of three well-separated atoms can be developed as a multipolar expansion, each of whose term is the product of a geometrical factor and an interaction constant. This letter gives values of the interaction constants for a number of terms in the multipolar expansion for three hydrogen atoms. They should be accurate to within about 0.1%. (auth) (UK)

35165 MULTIPOLAR EXPANSION FOR NONADDITIVE THIRD-ORDER INTERACTION ENERGY OF THREE ATOMS. Bell, R. J. (National Physical Lab., Teddington, Eng.). J. Phys., B (London); 3: 751-62(Jun 1970).

A multipolar expansion is given for the nonadditive third-order interaction energy of three well-separated atoms, in spherically symmetric states. Each term in the expansion can be written as the product of a geometrical factor W, depending only on the relative positions of the three atomic nuclei, and an interaction constant Z, which depends solely on the atomic species involved in the interaction. Explicit formulae are presented for the first few W factors, namely those involved in the dipole-dipole-dipole, dipole-dipole-quadrupole, dipole-quadrupole-quadrupole and quadrupole-quadrupole-quadrupole terms. The formula for the dipole-dipole-dipole case is equivalent to Axilrod and Teller's (1943) expression for the three-body van der Waals energy. In the dipole-dipole-quadrupole case, however, the result is in disagreement with an earlier calculation by Ayres and Tredgold (1956). Formulae for the other two W factors have not appeared previously in the literature. Approximate values of the Z constants are also presented, in the four cases mentioned, for triplets of rare-gas atoms. (auth) (UK)

35166 HYDROGEN ATOM IN THE PRESENCE OF THE FERMI-CONTACT INTERACTION. Velenik, A.; Zivkovic, T.; de Jeu, W. H.; Murrell, J. N. (Univ. of Sussex, Brighton, Eng.). Mol. Phys.; 18: 693-6(May 1970).

It is shown that the energy associated with the Fermi-contact part of the hamiltonian of the hydrogen atom cannot be expanded as a perturbation series. A variation calculation shows that the total energy is E_0 when the Fermi-contact operation is added to H_0, and $-\infty$ when it is subtracted. In order to do a priori variational calculations on the "second-order" properties of this operator, such as spin-spin coupling constants, it is probably necessary to remove the singularity caused by the δ function. (auth) (UK)

35167 ENERGIES OF THE $K\alpha_1$, $K\alpha_2$, $K\beta_1$, AND $K\beta_3$ X RAYS AND THE K-SHELL BINDING ENERGIES IN Np, Pu, AND Am. Nelson, G. C. (Univ. of California, Livermore); Saunders, B. G.; Salem, S. I. Z. Phys.; 235: 308-12(1970).

The energies of the $K\alpha_1$, $K\alpha_2$, $K\beta_1$, and $K\beta_3$ x rays in Np, Pu, and Am were measured with a Cauchois-type bent-crystal spectrometer. The K-shell binding energies were determined by combining the measured $K\alpha$ and $K\beta$ x-ray energies with the previously determined L_{II}, L_{III}, M_{II}, and M_{III} binding energies. The $L_{II}-L_{III}$ and $M_{II}-M_{III}$ binding energy differences obtained from the $K\alpha_1-K\alpha_2$ and $K\beta_1-K\beta_3$ x-ray energies agree, within the experimental error, with the differences obtained from the L_{II}, L_{III}, M_{II}, and M_{III} binding energies previously reported. (auth)

35168 THRESHOLD BEHAVIOR FOR PHOTO DOUBLE IONIZATION. Parr, Albert C.; Ingham, Mark G. (Univ. of Chicago). J. Chem. Phys.; 52: 4916-17(1 May 1970).

An ytterbium atomic beam generated in a Knudsen cell and crossed with a photon beam in the source of a mass spectrometer was used to study the photo double ionization process in Yb in order to determine threshold behavior of the ionization cross section. The ionization efficiency curve obtained for the double ionization process rises linearly from onset at 18.35 ± 0.10 eV. Based on a value of 6.25 eV for the ionization potential of Yb I, the ionization potential of Yb II was found to be 12.11 ± 0.10 eV. (A.G.W.)

35169 NOTE ON THE LYMAN SYSTEM OF HD. Allison, A. C. (Smithsonian Astrophysical Observatory, Cambridge, Mass.). J. Chem. Phys.; 52: 4909-10(1 May 1970).

Calculations of the relative intensity of certain transitions in the Lyman system of HD were made, taking into account the variation of the dipole moment with internuclear distance. The results are compared with experimental results and with calculations based on Franck-Condon factors. The present results follow the measured values more closely than the Franck-Condon factor calculations. (A.G.W.)

35170 POTENTIAL-ENERGY CURVES FOR THE He_2 MOLECULE. Ginter, Marshall L. (Univ. of Maryland, College Park); Battino, Rubin. J. Chem. Phys.; 52: 4469-74(1 May 1970).

Potential-energy curves for the stable Rydberg states of He_2, constructed using RKR procedures, are presented and discussed. The presentation is essentially complete for all states lying below approximately 0.8 eV of N = 0, v = 0 of $X\,^2\Sigma_u^+$ (He_2^+), while the relative positions of the molecular and separated-atom term manifolds are probably within 0.03 to 0.04 eV. Whenever possible, the RKR results are compared with theoretically computed potential energies. (auth)

35171 NEW METHOD FOR ORIENTING EXCITED ATOMIC LEVELS BY OPTICAL PUMPING. APPLICATION TO THE MEASUREMENT OF THE HYPERFINE STRUCTURE OF ^1D LEVELS OF ^3He. Pavlovic, Milica; Laloe, Franck (Ecole Normale Superieure, Paris). J. Phys. (Paris); 31: 173-94 (Feb-Mar 1970). (In French).

A new method for orienting excited states is reported. The three following processes are involved: a nuclear orientation in the ground state of the atoms is achieved by optical pumping; a rf discharge in the vapor populates the various excited levels of the atoms, without destroying the orientation of the nuclei; in each excited state, this nuclear orientation can be transformed by the hyperfine coupling in an electronic orientation, which can be easily detected by the polarization of the emitted light. Theoretical study of the electronic orientation obtained by this method is presented as a function of the parameters of the excited state and of the static magnetic field. This method has been used to orient various excited levels of ^{3}He. A detailed study of the effect of the hyperfine decoupling in the 3 ^{1}D, 4 ^{1}D, 5 ^{1}D levels has shown a good agreement between experimental results and theory, and yields a measurement of the hyperfine structure of these levels. (auth) (France)

35172 THE HYDROGEN ATOM IN THE DIRAC–HESTENES THEORY. Casanova, Gaston. Compt. Rend., Ser. A; 270: 1202-4(4 May 1970). (In French).

There are, for the Dirac–Hestenes wave functions, plane solutions that lead to the same energy levels as the well known Dirac spherical solutions, and for which the Takabayasi–Hestenes angle $\beta = 0 \pm 2\pi$, according to the Dirac–Hestenes convention for the negatrons. (auth)

Positronium, Muonium, and Mesic Atoms and Molecules

35173 DEPOLARIZATION OF μ^+ MESONS IN ALKALI METAL HALIDE COMPOUNDS. Myasishcheva, G. G.; Obukhov, Yu. V.; Roganov, V. S.; Surorov, L. Ya.; Firsov, V. G. Khim. Vys. Energ.; 3: 507-9(Nov-Dec 1969). (In Russian).

The time dependence of polarization of μ^+ mesons in various forms of lithium fluoride at different temperatures was measured. The effect of impurities in crystals of alkali metal halides on the coefficient of μ–e decay was studied. (tr-auth)

35174 CORRECTIONS TO THE POSITRONIUM HYPERFINE STRUCTURE OF ORDER $\alpha^2 \ln\alpha^{-1}$. Fulton, Thomas (CERN, Geneva); Owen, David A.; Repko, Wayne W. Phys. Rev. Lett.; 24: 1035-7(11 May 1970).

A calculation of the $m\alpha^6 \ln\alpha^{-1}$ contributions to the triplet–singlet splitting of the positronium ground state is reported. The result, $\Delta\nu(\alpha^6 \ln\alpha^{-1}) = \frac{1}{2}m\alpha^6 \ln\alpha^{-1} = 46$ MHz, shifts the theoretical prediction from two standard deviations below to two standard deviations above the most recent experimental value. (auth)

35175 PASCHEN–BACK EFFECT FOR THE MUONIUM ATOM. Minaichev, E. V.; Myasishcheva, G. G.; Obukhov, Yu. V.; Roganov, V. S.; Savel'ev, G. I.; Firsov, V. G. Zh. Eksp. Teor. Fiz.; 58: 1586-92(May 1970). (In Russian).

The polarization of μ^+ mesons as a function of longitudinal magnetic field strength is measured between 0 and 3 kOe in single-crystal quartz and corundum. For quartz the experimental data are found to be in good agreement with the theory of muonium depolarization. The experimental value of the critical magnetic field strength for muonium in quartz equals, within the experimental errors, the value obtained in vacuum. The possibilities that the method affords for measuring the size of muonium in various media are considered. (auth)

Collision Phenomena

Refer also to abstracts 35111 and 35632.

35176 (GA-10133) ENERGY DEPOSITION STUDIES. Annual Summary Report Ending August 31, 1970. Vroom, D. A. (Gulf General Atomic, Inc., San Diego, Calif.). 22 May 1970. Contract AT(04-3)-167. 36p. Dep. CFSTI.

Progress is reported for the period September 1969 to August 1970 on measurement of secondary electron emission cross sections for several gases subjected to high-energy electron impact. Secondary electron emission cross sections differential in energy and in angle is presented for methane and hydrogen ionized by electrons of 1 to 10 keV. A computer program prepared this year was used to place earlier results for nitrogen on an absolute scale; these results are included. Results for argon are reported in an article being submitted for journal publication; a copy of the article is included as an appendix. (A.G.W.)

35177 (GA-10135) ENERGY DEPOSITION STUDIES. Three-Year Summary Report Ending August 31, 1970. Vroom, D. A. (Gulf General Atomic, Inc., San Diego, Calif.). 22 May 1970. Contract AT(04-3)-167. 104p. Dep. CFSTI.

The main research accomplishments and apparatus built during a three-year study of energy deposition by fast particles in gases are summarized. Some data on angular distributions of secondary electrons from impact of 1- to 10-keV electrons on argon, methane, nitrogen, and hydrogen are included, but more details are given in the annual report GA-10133 and in articles being prepared for publication. Results of photoionization studies have been published; reprints of three papers giving these results are included in an appendix. Plans for continuation of the program are outlined. (A.G.W.)

35178 (ORO-3798-50) CHARGED PARTICLE IMPACT PHENOMENA IN SIMPLE SYSTEMS. Progress Report and Renewal Proposal. Green, Alex E. S. (Florida Univ., Gainesville. Dept. of Physics and Astronomy). 1 Jun 1970. 102p. Dep. CFSTI.

Work under way in programs on aeronomy and energy degradation of electrons is summarized briefly. Proposed research on energy degradation of protons is outlined. A proposed Interdisciplinary Center for Aeronomy and Planetary Atmospheres is described in detail with regard to purpose, administrative structure, existing resources and facilities, budget, and personnel. Copies of two papers prepared for publication and for oral presentation, respectively, are included. Subjects are "Analytic Cross Sections for Inelastic Collisions of Protons and Hydrogen Atoms with Atomic and Molecular Gases" and "Atomic Physics and Aeronomy." (A.G.W.)

35179 COUPLED-STATE CALCULATIONS OF PROTON–HYDROGEN SCATTERING WITH A PSEUDO-STATE EXPANSION. Cheshire, I. M.; Gallaher, D. F.; Taylor, A. Joanna (Atomic Energy Research Establishment, Harwell, Eng.). J. Phys., B (London); 3: 813-32(Jun 1970).

Cross sections for proton–hydrogen scattering are calculated using the close-coupling method. The wave function is expanded in four hydrogenic states and three orthogonal pseudostates chosen for rapid convergence and numerical convenience. There is good agreement between the results and experimental values. (auth) (UK)

35180 ELASTIC SCATTERING OF Li^+ BY He. Catlow, G. W. (Univ. of Western Ontario, London); McDowell, M. R. C.; Kaufman, J. J.; Sachs, L. M.; Chang, E. S. J. Phys., B (London); 3: 833-49(Jun 1970).

A linear combination of atomic orbitals–self-consistent field–molecular orbital (LCAO–SCF–MO) calculation of the interaction potential of the ground state of $LiHe^+$ is reported, and the results are compared with other quantal calculations and with semiempirical potentials. The potential is used to investigate the elastic scattering of Li^+ by He. Values of the differential cross section $I(\theta)$, the cross section for scattering through an angle $\theta > \theta_0$, $S(\theta_0)$, total elastic cross section $Q_{el}(k^2)$, diffusion cross section $Q_D(k^2)$, and mobility K(T) are obtained and compared with experiment. Excellent agreement is obtained except for $I(\theta)$, $\theta_{cm} > 70°$. Orbiting occurs at $k = 0.03$ ($l = 2$) and $k = 0.34$ ($l = 7$). Seven nonorbiting oscillations are found in $Q_{el}(k^2)$, and seven bound vibrational states are predicted. (auth) (UK)

35181 POLARIZATION OF LITHIUM AND SODIUM ATOM RESONANCE LINES EXCITED BY ELECTRON IMPACT. Karule, E. (Inst. of Physics, Salaspils, USSR). J. Phys., B (London); 3: 860-4(Jun 1970).

The polarizations of the resonance lines of ^{6}Li, ^{7}Li, and ^{23}Na, excited by electron impact, are calculated close to the excitation threshold using a theory of Percival and Seaton (1958). The results obtained are compared with experimental values of Hafner and Kleinpoppen (1967). (auth) (UK)

35182 ANGULAR DISTRIBUTIONS OF IONS RESULTING FROM ELECTRON IMPACT ON RARE GASES. McConkey, J. W.; Newell, W. R.; Crowe, A. (Queen's Univ., Belfast). J. Phys., B (London); 3: L55-7(Jun 1970).

Anisotropies were observed in the angular distributions of ions resulting from electron impact on the rare gases. This work complements the measurements on the angular distributions of scattered electrons resulting from the ionization process. (auth) (UK)

35183 1s–2p EXCITATION IN e–H COLLISIONS BY THE GLAUBER APPROXIMATION. Ghosh, A. S.; Sinha, P.; Sil, N. C. (Indian Association for the Cultivation of Science, Calcutta). J. Phys., B (London); 3: L58-60(Jun 1970).

The total cross section for 1s–2p excitation in e–H collisions was calculated by the Glauber (1959) approximation. In the intermediate energy region the results are in satisfactory agreement with the experimental findings. (auth) (UK)

35184 MEASUREMENTS OF THE RATIO OF CROSS SECTIONS FOR PENNING IONIZATION BY He(2^1S) AND He(2^3S)

METASTABLE ATOMS. Dunning, F. B.; Smith, A. C. H. (University Coll., London). J. Phys., B (London); 3: L60-3(Jun 1970).

The ratio of the cross sections for Penning ionization of Ar, Kr, Xe, O_2, N_2, CO, NO, and H_2 by thermal-energy He(2^3S) and He(2^1S) metastable atoms was measured using a beam–gas-cell technique. Where comparisons can be made, the ratios are in good agreement with previous gas cell measurements, but disagree with results obtained in afterglow studies. (auth) (UK)

35185 BOUND-STATE CALCULATION OF SCATTERING RESONANCE ENERGIES. Weiss, A. W.; Krauss, M. (National Bureau of Standards, Washington, D. C.). J. Chem. Phys.; 52: 4363-8(1 May 1970).

Resonance energies in electron scattering are estimated by calculating bound trial functions that represent electron attachment to the lowest Rydberg state. The trial functions are kept orthonormal to a single-configuration description of the target state and so represent an approximation to the Feshbach procedure. Correlated trial functions are used for $He^-(^2S)$, $Ne^-(^2P)$, and $Ar^-(^2P)$. The resonant-energy predictions are in good agreement with observation. In addition, the correlation energies for the ns^2 pairs range from 0.55 to 0.75 eV. These correlation energies are used to correct Hartree–Fock estimates of resonance energies computed for the HF, H_2O, and N_2 molecules. Energy curves obtained for $HF^-(^2\Pi)$ indicate a dissociative attachment process is possible that leads to production of the H^- ion. Only single points are calculated for H_2O but the $^2B_1$ resonance state is assigned to a dissociative attachment at 6.5-eV incident electron energy that yields the H^- ion. In addition to the attachment to Rydberg excited states, two N_2 valence-type Feshbach states are calculated. The results for $\sigma_g\,\pi_g^2$, $^4\Sigma_g^-$, and $^2\Delta_g$, when used with correlation energy estimates lead to the conclusion that valence-type Feshbach states are not bound relative to their concomitant neutral excited valence state. Sharp resonances would not then be expected below such neutral states. (auth).

35186 ELECTRON EXCITATION CROSS SECTIONS FOR SOME N V MULTIPLETS. Davis, J. (EG and G, Inc., Albuquerque, N. Mex.); Morin, S. J. Chem. Phys.; 52: 4410-13(1 May 1970).

Calculations of the electron excitation cross sections for multiplets 2, 3, 4, and 5 of N v over the energy range 4 to 100 eV are presented. The cross sections were estimated by utilizing a weak-coupling semiclassical impact theory. (auth)

35187 IONIZATION AND METASTABLE EXCITATION IN LOW-ENERGY COLLISIONS OF GROUND-STATE ARGON ATOMS. Haugsjaa, Paul O.; Amme, Robert C. (Univ. of Denver). J. Chem. Phys.; 52: 4874-7(1 May 1970).

A low-energy beam of argon atoms, formed by nonresonant charge transfer of Ar^+ in H_2, was used to explore the near-threshold behavior for ionizing and exciting collisions between argon atoms. For excess center-of-mass energies below 12 eV, the ionization data are consistent with the empirical relationship $\sigma_- \approx 1.8 \times 10^{-21}\,(E - 15.8)^{1.3}$, where E is the center-of-mass energy in electron volts. Target-gas mixtures of argon and acetylene were used in an effort to observe metastable atoms formed in atom–atom collisions by Penning ionization. In this case, beam energies were restricted to values less than 30 eV to avoid direct ionization of the acetylene (Penning) gas by the ground-state atom beam. At 14.5 eV cms energy, the cross section for metastable production is shown to be $(3.6 \pm 2.4) \times 10^{-20}$ cm^2, but this value is dependent upon assumed values of the Penning cross section for $Ar^* + C_2H_2$ collisions. (auth)

35188 CALCULATION OF TRANSITION PROBABILITIES FOR COLLINEAR ATOM–DIATOM AND DIATOM–DIATOM COLLISIONS WITH LENNARD–JONES INTERACTION. Gutschick, Vincent P. (California Inst. of Tech., Pasadena); McKoy, Vincent; Diestler, Dennis J. J. Chem. Phys.; 52: 4807-17(1 May 1970).

Numerical integration of the close-coupled scattering equations is performed to obtain vibrational-transition probabilities for three models of the electronically adiabatic H_2–H_2 collision. All three models use a Lennard–Jones interaction potential between the nearest atoms in the collision partners. The results are analyzed for some insight into the vibrational excitation process, including the effects of anharmonicities in the molecular vibration and of the internal structure (or lack of it) in one of the molecules. Conclusions are drawn on the value of similar model calculations. Among them is the conclusion that the replacement of earlier and simpler models of the interaction potential by the Lennard–Jones potential adds very little realism for all the complication it introduces. (auth)

35189 ELECTRON SCATTERING BY H_2 WITH AND WITHOUT EXCITATION. III. EXPERIMENTAL AND THEORETICAL STUDY OF INELASTIC SCATTERING. Trajmar, S.; Truhlar, D. G.; Rice, J. K.; Kuppermann, A. (California Inst. of Tech, Pasadena). J. Chem. Phys.; 52: 4516-33(1 May 1970).

The ratios of the differential cross sections (DCS's) for excitation of the first, second, and third vibrational states of H_2 in its ground electronic state to the elastic DCS were measured as a function of scattering angle in the 10° to 80° range and impact energy in the 7- to 81.6-eV range. From these ratios the DCS's corresponding to transitions from the ground to the first two vibrationally excited levels (fundamental and first overtone bands) were obtained by utilizing the elastic cross sections determined in Part II of this series. In addition, the DCS for excitation of the second overtone band was determined for an impact energy of 10 eV. By angular extrapolation and integration of the DCS's the integral cross sections for the vibrational excitations were also determined. In addition, all these cross sections were calculated using a quantum-mechanical method based on potential scattering in a plane-wave scattering approximation described in Part I of this series. The present experimental and theoretical cross sections and previous measurements and calculations are compared. The calculated DCS ratios and the DCS's themselves for the fundamental excitation are in good agreement with experiment at 7 and 10 eV; however, at higher energies the calculated DCS's are generally larger than the experimental ones, at some angles by as much as a factor of 10. The calculated ratio of the DCS for the fundamental excitation to the elastic DCS shows a minimum as a function of angle, in qualitative agreement with the experimental results in the 13.6- to 81.6-eV energy range. The experimental DCS's for vibrational excitation also show a deep minimum. For excitation of the first overtone vibration, the experimental ratios are an order of magnitude larger than the calculated ones at low energy but in better agreement for the magnitude at higher energy. This discrepancy at low energies is explained in terms of resonance scattering. These experiments are in good agreement with those of others in the few (low-energy) cases where comparison is possible. (auth)

35190 ELECTRON SCATTERING BY H_2 WITH AND WITHOUT VIBRATIONAL EXCITATION. II. EXPERIMENTAL AND THEORETICAL STUDY OF ELASTIC SCATTERING. Trajmar, S.; Truhlar, D. G.; Rice, J. K. (California Inst. of Tech., Pasadena). J. Chem. Phys.; 52: 4502-15(1 May 1970).

Elastic scattering of electrons by the hydrogen molecule was studied. The differential elastic cross sections were determined experimentally from 10° to 80° at seven impact energies ranging from 7 to 81.6 eV. The experimental methods for measuring the relative elastic scattering intensities, the transformation of these intensities into relative cross sections, and their normalization to the absolute scale are presented. The elastic differential and integral cross sections were also calculated in this energy range by the quantum-mechanical method described in Part I of this series. A comparison is made between the experimental and the calculated cross sections and, whenever possible, with the results of other investigators. It is found that in the energy and angular ranges investigated here, polarized Born and polarized Born–Ochkur–Rudge approximations using the theoretically most justified potential give better agreement with experiment than any previous calculation and that the inclusion of polarization is necessary to obtain accurate cross sections at low scattering angles. (auth)

35191 ELECTRON SCATTERING BY H_2 WITH AND WITHOUT VIBRATIONAL EXCITATION. I. QUANTUM-MECHANICAL THEORY. Truhlar, D. G.; Rice, J. K. (California Inst. of Tech., Pasadena). J. Chem. Phys.; 52: 4480-4501(1 May 1970).

A quantum-mechanical model of elastic and inelastic electron scattering by a homonuclear diatomic molecule in its electronic ground state is presented. The model should be especially useful in the intermediate energy range (about 10 to 100 eV). It is applied to the calculation of differential and integral cross sections for elastic scattering and for excitation of the first, second, and third vibrational states of molecular hydrogen for impact energies in the 1- to 912-eV range. The theory assumes plane waves for the scattering-electron wave functions; it includes electron exchange effects by use of the Born–Ochkur–Rudge approximation, and it incorporates an electron–H_2 interaction potential containing a semiempirical polarization potential and a static potential that includes a semiempirical quadrupole interaction. These potentials are adjusted to agree with available ab initio calculations of these potentials. The effects on the cross sections of electron exchange and the scattering by the various potential terms are examined to elucidate which aspects are important for a detailed mechanism and for contrast with previous incomplete treatments. In particular, calculations using only the long-range interactions give results too small by a factor of 2 or more (when compared to the full calculation) for $v' = 1$ at $E > 13$ eV and for $v' > 1$ at all en-

ergies (v' is the vibrational quantum number of the molecule after the collision). The calculations of elastic scattering are compared with high-energy experimental differential cross sections and with theoretical and experimental low-energy cross sections. A formalism that treats the s and p scattering partial waves in the restricted distorted-wave approximation while retaining the plane-wave scattering approximation for all higher partial waves is also presented. (auth)

35192 PAULI EXCITATION OF ATOMS IN COLLISION. Brandt, Werner; Laubert, Roman (New York Univ., N. Y.). Phys. Rev. Lett.; 24: 1037-40(11 May 1970).

Experimental cross sections are reported for the ionization of K shells of Al in collision with N, O, and Ar (in the energy range 100 to 300 keV); of Ne with C, Ne, and Al (100 to 300 keV); and of Al with Ne (0.1 to 3.2 MeV). They are some 10^3 to 10^5 times larger than the cross sections predicted for Coulomb excitation of K-shell electrons by swift charged particles. The cross sections are determined by the exchange forces set up in the overlapping electron clouds of atoms in collision. This process is referred to as Pauli excitation. (auth)

35193 SLOW COLLISIONS IN A THREE BODY SYSTEM INVOLVING COULOMB INTERACTION. III. SCATTERING LENGTHS FOR COLLISION PROCESSES BETWEEN HYDROGEN MESOATOMS. Matveenko, A. V.; Ponomarev, L. I. (Joint Inst. for Nuclear Research, Dubna, USSR). Zh. Eksp. Teor. Fiz.; 58: 1640-5(May 1970). (In Russian).

The scattering lengths and the limits of applicability of this concept are determined for symmetric charge-exchange processes in hydrogen mesoatoms by applying the phase function technique. The values of the scattering lengths for processes involving H, D, and T in even (a_g) and odd (a_u) channels are presented in the table. (auth)

35194 NEGATIVE ION FORMATION AND DE-EXCITATION OF THE HYDROGEN 2s LEVEL IN SLOW COLLISIONS. Vitlina, R. Z.; Chaplik, A. V. (Inst. of Semiconductor Physics, Novosibirsk, USSR). Zh. Eksp. Teor. Fiz.; 58: 1798-1802(May 1970). (In Russian).

The $H^* + A = H^+ + A^-$ reaction, where H^* is the hydrogen atom in the second quantum level, is considered. The charge-exchange probability and probability for radiative de-excitation of the 2s metastable state are found in the adiabatic approximation. (auth)

35195 BORN CROSS SECTION FOR THE n–n' TRANSITION IN HYDROGEN ATOMS INDUCED BY ELECTRON IMPACT. Beigman, I. L.; Urnov, A. M.; Shevel'ko, V. P. (Lebedev Inst. of Physics, Moscow). Zh. Eksp. Teor. Fiz.; 58: 1825-9(May 1970). (In Russian).

An analytic expression for the total (with respect to l and l') squared Born amplitude for the n–n' transition is obtained by means of the Coulomb Green's function. The formula can be significantly simplified in the limiting cases of large values of n and n'. An expression for the transition cross section is obtained at high electron energies, which is similar to the Kramer's approximation for oscillator strength ($1 \ll \Delta n \ll n$). (auth)

35196 DIFFERENTIAL COLLISION CROSS-SECTION MEASUREMENTS IN THE ELASTIC SCATTERING OF LIGHT IDENTICAL MOLECULES: HELIUM. Cavallini, M.; Meneghetti, L.; Scoles, G.; Yealland, M. (Univ., Genoa). Phys. Rev. Lett.; 24: 1469-71(29 Jun 1970).

Differential collision cross sections in the elastic scattering of helium beams are reported. A supersonic room-temperature primary beam and a multichannel low-temperature secondary beam were used. The first quantum oscillation was resolved. The results are compared with cross sections computed numerically, describing the interaction by means of potentials previously reported in the literature. Computed predictions are in fair agreement with experimental results. (auth)

35197 SPIN POLARIZATION BY INELASTIC ELECTRON–ATOM COLLISIONS. Eitel, W.; Kessler, J. (Univ., Karlsruhe, Ger.). Phys. Rev. Lett.; 24: 1472-3(29 Jun 1970).

Measurements of electron spin polarization resulting from inelastic electron scattering by mercury (excitation of the 6^1P_1 state; 6.7-eV energy loss) are reported. The angular dependence of the polarization was measured for incident energies of 25, 30, 50, and 180 eV. (auth)

35198 MEASUREMENT OF CHARGE-EXCHANGE AND IONIZATION CROSS SECTIONS OF 40 TO 400 keV HYDROGEN IONS AND ATOMS IN LITHIUM. D'yachkov, B. A. This paper was summarized in At. Energ. (USSR); 27: 220-1(Sep 1969) as paper No. 339/4597. (In Russian).

Measurements of the charge-exchange cross sections for protons and the cross sections for ionization of neutral hydrogen atoms in lithium at energies from 40 to 400 keV are reported. The measured values are compared with results of other investigators. (A.G.W.)

35199 INCLUSION OF HIGHER-STATE COUPLINGS IN A MULTI-STATE IMPACT-PARAMETER TREATMENT OF HEAVY-PARTICLE COLLISIONS. Flannery, M. R. (Smithsonian Astrophysical Observatory, Cambridge, Mass. Harvard Coll. Observatory, Cambridge, Mass.). J. Phys., B (London); 3: 798-803 (Jun 1970).

The customary impact-parameter equations describing heavy-particle collisions are modified so as to take proper account of the neglected couplings to states not explicitly included in the basis-set expansion for the electronic wave functions. For ion–atom impact in particular, two approximations are then proposed in an effort to consider the separate effects of long-range couplings between the ground state and all states (including the continuum) and of the polarization distortion produced by the incoming ion on the polarizable discrete states of the atom. (auth) (UK)

35200 EFFECT OF ATOMIC DISTORTION ON ELECTRON SCATTERING FROM MERCURY. Walker, D. W. (Univ. of Melbourne). J. Phys., B (London); 3: 788-97(Jun 1970).

Previously reported scattering calculations from mercury, including electron exchange effects, are extended by the inclusion of a "polarization potential" that describes the distortion of the atom by the incident electron. Although a slight improvement in agreement with experiment is obtained, the results indicate that the adiabatic approximation used overestimates this distortion effect rather greatly. (auth) (UK)

35201 INELASTIC SCATTERING OF HIGH-ENERGY ELECTRONS BY ATMOSPHERIC GASES. Lassettre, E. N. (Carnegie-Mellon Univ., Pittsburgh). Can. J. Chem.; 47: 1733-74(15 May 1969).

Inelastic scattering of electrons by nitrogen, oxygen, carbon monoxide, carbon dioxide, water, argon, and helium is reviewed. Electron-impact spectra at both high (less than 40 keV) and low (greater than 15 eV) kinetic energies are presented and discussed. Collision cross sections and generalized oscillator strengths are described, when data are available, and the connection with optical oscillator strengths is discussed. The limiting selection rules that hold in the excitation of atoms and molecules by electron impact are discussed and typical examples of forbidden transitions are described. (auth) (Canada)

35202 ELASTIC DIFFERENTIAL SCATTERING OF H^+, He^+, AND He^{++} BY ARGON IN THE 150 TO 2000-eV RANGE. Snyder, Robert Stuart. Charlottesville, Va.; Univ. of Virginia (1969). 59p.

Thesis.

Elastic differential cross sections for H^+, He^+, and He^{2+} scattered by argon were measured at relative energies from 150 to 2000 eV and scattering angles from ½° to 20°. The ions were obtained from an electron bombardment source and analyzed magnetically to select the proper mass and charge state. After the ions were scattered in a gas cell containing argon gas at a low pressure, the scattered ions were energy analyzed and detected at a measured angle. The procedure for obtaining the data was to select the ion and its energy, E, and examine the elastically scattered ion current as a function of the scattering angle, Θ. The data are expressed in terms of the reduced elastic differential scattering cross section $\rho(\tau,E) = \Theta \sin \Theta \sigma(\Theta,E)$ where $\tau = E\Theta$ is the reduced scattering angle. The results are interpreted in terms of potential energy functions suggested for the interaction between an incident ion and target atom. A screened Coulomb repulsive potential with an attractive polarization term describes the data. (Disser. Abstr. Int., B)

35203 VTORICHNAYA ELEKTRONNAYA EMISSIYA. (Secondary Electron Emission). Bronshtein, I. M.; Fraiman, B. S. Moscow; Izdatel'stvo Nauka (1969). 408p.

Methods of measurement of the coefficient of secondary emission and the energy distribution of secondary electrons are examined. The basic characteristics of secondary emission at low primary electron energies and the roles of elastic and inelastic reflection of electrons are considered. Secondary emission in metals, dielectrics, and elementary semiconductors is discussed. The statistics of secondary emission and the effects of angle of incidence of the primary electrons are also considered. 1035 references. (A.G.W.)

35204 FIELD-THEORETIC VIEW OF ATOM–ATOM COLLISIONS. Chowdhury, A. Roy (Jadavpur Univ., India). Indian J. Phys.; 43: 464-7(Aug 1969).

In this field theoretic treatment of atom–atom collisions, the

nonrelativistic interaction potential is shown to be a consequence of the field interactions. The approach is quite general and can presumably be used to evaluate the interaction potential and cross section for more complex systems. (A.G.W.)

35205 1s–2s EXCITATION IN e-H COLLISION BY GLAUBER APPROXIMATION. Ghosh, A. S.; Sil, N. C. (Indian Association for the Cultivation of Science, Calcutta). Indian J. Phys.; 43: 490-1(Aug 1969).

The Glauber approximation is used to calculate cross sections for 1s–2s excitation in electron–hydrogen scattering. Results are compared with calculations based on the Born and Ochkur approximations and with experimental values. Cross sections obtained by Born and Glauber approximations are nearly identical for energies between 100 and 200 eV, and these are in good agreement with the experimental findings in this region. Below 100 eV the results of the Glauber calculation lie below the Born and Ochkur results. (A.G.W.)

35206 INCOHERENT SCATTERING OF GAMMA RAYS BY K-SHELL ELECTRONS. Chintalapudi, Surya N.; Parthasaradhi, K. (Andhra Univ., Waltair, India). Indian J. Phys.; 43: 492-3 (Aug 1969).

Incoherent scattering functions for 662- and 320-keV gamma rays in Pb, Ta, and Sm at various scattering angles were calculated by use of an expression developed by Shimuju et al. (Phys. Rev., 140A: 806 (1965)). A comparison with experimental values shows that at both energies in all elements the calculated values follow the same trend as the experimental values, but in most cases the theoretical values are smaller than the experimental values. Agreement is better as energy, angle, and atomic number increase. (A.G.W.)

35207 SEMI-EMPIRICAL ELECTRON IMPACT CROSS SECTIONS FOR ATMOSPHERIC GASES. Peterson, L. R.; Prasad, S. S.; Green, A. E. S. (Univ. of Florida, Gainesville). Can. J. Chem.; 47: 1774-80(15 May 1969).

The electron-impact cross sections for N_2, O_2, and O used in recent aurora and dayglow studies at the University of Florida are summarized. The cross section parameters in their present form are a natural outgrowth of (a) the availability of an increasing number of cross section measurements in the laboratory as well as field observations of spectral intensities, and (b) more realistic calculations. The values presented should serve as a useful interim reference list pending full analyses of current extensive data. Their usefulness for practical applications to problems in aeronomy is enhanced by their integrable functional forms. (auth) (Canada)

35208 SUDDEN APPROXIMATION AS APPLIED TO VIBRATIONALLY INELASTIC SCATTERING. Wartell, M. A.; Cross, R. J. Jr. (Yale Univ., New Haven). Chem. Phys. Lett.; 5: 477-9(1 Jun 1970).

The sudden approximation is used to calculate transition probabilities for vibrationally inelastic scattering in the cms energy range of 0.17 to 17 eV. The system studied was He + H_2 using the potential of Krauss and Mies. Effects of concurrent rotationally inelastic scattering and the orientation dependence of the potential were included in the calculations. In general, collinear collisions were found to give the largest energy transfer, although there were large transition probabilities for other orientations of the molecule and for nonzero impact parameters. (auth)

35209 CROSS SECTIONS FOR ELECTRON CAPTURE BY 0.3- TO 70-keV DEUTERONS IN H_2, H_2O, CO, CH_4, AND C_3F_{16} GASES. Berkner, K. H.; Pyle, R. V.; Stearns, J. W. (Univ. of California, Berkeley). Nucl. Fusion; 10: 145-9(Jun 1970).

Electron-capture cross-section measurements are reported for 0.3- to 70-keV deuterons in H_2, H_2O, CO, CH_4, and C_3F_{16} gases. The experimental apparatus and the method employed, slow-ion collection, are described. The results are discussed, particularly the low-energy behavior in molecular hydrogen. (auth)

35210 ABSOLUTE MEASUREMENT OF TOTAL IONIZATION CROSS SECTION OF Mg BY ELECTRON IMPACT. Okuno, Yasuko; Okuno, Kazuhiko; Kaneko, Yozaburo; Kanomata, Ichiro (Tokyo Metropolitan Univ.). J. Phys. Soc. Jap.; 29: 164-72 (Jul 1970).

The total ionization cross section of Mg by electron impact was measured absolutely by the crossed-beam technique. The intensity of the neutral Mg beam was determined by the deposition method. Mg atoms deposited onto a beam collector were quantitatively analyzed by atomic absorption spectrophotometry. The absolute cross sections at 22.4, 106, 492, and 1000 eV were determined to be 9.1, 3.9, 1.7, and 1.0×10^{-16} cm^2, respectively. Systematic errors were estimated to be within −15% and +8%. The relative cross section was obtained as a function of electron energy from the threshold to 1130 eV. The results are compared with some experimental results and theoretical calculations by other workers. (auth)

35211 ROTATIONAL EXCITATION OF DIATOMIC MOLECULAR SYSTEMS. II. H_2^+. Chang, Edward S.; Temkin, A. (Goddard Space Flight Center, Greenbelt, Md.). J. Phys. Soc. Jap.; 29: 172-9(Jul 1970).

Rotational excitation cross sections of H_2^+ by electron impact are evaluated in the adiabatic approximation from phase shifts of previous papers based on the method of single-center polarized orbitals. In consonance with classically averaged fixed-nuclei cross sections of the previous papers, it is found here that the quantitative changes due to polarization and permanent distortion on rotational excitation are also small. However, the relative sizes of these two effects are interchanged with permanent distortion here being more important; the reasons for this are easily seen. In the first part of the paper, generalizations of the formulas of the adiabatic theory for a charged molecular target (molecular ion) are given. It is concluded in that case that the adiabatic theory can be made to be accurate down to an energy $k^2 \gg (m/M)\Delta E$ (rotational). In the case of neutral target molecules it is argued that the lower limit is given by $k^2 \geq 1.65\ E\Delta$ (rotational), and that the theory of Gerjuoy and Stein can be used at lower impacting energies. (auth)

Atomic Theory

Refer also to abstracts 35911, 35914, and 35915.

35212 RASPREDELENIE ATOMNYKH ELEKTRONOV I PRAVILO POSLEDOVATEL'NOGO ZAPOLNENIYA (n + l)-GRUPP. (Distribution of Atomic Electrons and the Rule of Progressive Saturation of (n + l) Groups). Klechkovskii, V. M. Moscow; Atomizdat (1968). 432p.

The theory of the periodic system of elements is considered in relation to spectra and structure of the electronic shells of atoms. The book represents a collection of previously published works of the author in which the concept of (n + l) groups was introduced and in which were presented strict formulations of the rule of successive filling of (n + l) groups and other rules pertaining to relationships discovered and formulated by grouping electronic states according to the sum of the principal and orbital quantum numbers. On the basis of these rules there is given, in particular, a strict physical interpretation of the combination of electronic subgroups, the filling of which occurs throughout the periodic system. Theoretical consequences and solutions resulting from this interpretation are considered. (tr-auth)

35213 METHOD OF NONLINEAR DEFORMATION OF EFFECTIVE CHARGE FOR THE CALCULATION OF THE POTENTIAL AND THE WAVE FUNCTIONS FOR A MANY-ELECTRON ATOM. Trusov, V. F. (Latvian State Univ., Riga). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 12, 15-18(1969). (In Russian).

A semiempirical method is proposed for construction of the potential of a many-electron atom based on the nonlinear deformation of the atomic core under the condition of best agreement between calculated and experimental binding energies for all subshells. The problem is solved in the relativistic approximation for the example of an atom of Hg. (tr-auth)

35214 1/Z PERTURBATION EXPANSION FOR THE NATURAL ORBITALS OF TWO-ELECTRON ATOMS. Wang, P. S. C. (Univ. of Georgia, Athens). J. Chem. Phys.; 52: 4459-63(1 May 1970).

A perturbation expansion of the natural orbitals and occupation numbers for two-electron atoms in inverse powers of the nuclear charge was obtained from the wave function of Hylleraas. To second order in 1/Z, the perturbation expansion gives the following principal occupation numbers: 0.99353 for He, 0.99712 for Li^+, 0.99837 for Be^{2+}, 0.99959 for O^{6+}; as compared to the results of Davidson for He (0.99200), and those of Marcias for Li^+ (0.9967), Be^{2+} (0.9982), and O^{6+} (0.9996), and also those of Kutzelnigg: 0.99303 for He, 0.99707 for Li^+, 0.99838 for Be^{2+}, and 0.99962 for O^{6+}. (auth)

35215 LOWER BOUNDS FOR THE OVERLAP OF APPROXIMATE WAVE FUNCTIONS. Wang, P. S. C. (Univ. of Georgia, Athens). J. Chem. Phys.; 52: 4464-7(1 May 1970).

A set of intermediate resolvents was constructed from the intermediate Hamiltonians introduced by Weinstein. From these intermediate resolvents a new formula was obtained for the lower bound of the overlap between the approximate and exact wave functions of a quantum-mechanical system. Special examples of these bounds are given and discussed. A new lower bound for the expectation values of positive Hermitian operators was derived in a similar way and included as an Appendix. (auth)

35216 RELATIVISTIC LONG-RANGE INTERACTIONS BETWEEN ATOMS AND MOLECULES. Chang, T. Y.; Karplus, M. (Harvard Univ., Cambridge, Mass.). J. Chem. Phys.; 52: 4698-4700(1 May 1970).

Lower and upper bounds for the coefficients of the leading term of the relativistic long-range two-body interactions are obtained by use of Padé approximants. Although the bounds are approximate, they provide an estimate of the importance of this contribution to the interaction energy for a variety of atoms and molecules. (auth)

35217 HEAVY ATOM IN AN ULTRASTRONG MAGNETIC FIELD. Kadomtsev, B. B. Zh. Eksp. Teor. Fiz.; 58: 1765-9 (May 1970). (In Russian).

The Hartree–Thomas–Fermi approximation for a heavy atom in an ultrastrong magnetic field considerably exceeding 10^{10} Oe is considered; complete rearrangement of the electron shells occurs in this case. It is demonstrated that spherical symmetry is preserved and the atomic radius decreases with the magnetic field strength in a certain range of its variation. The excitation levels of such an atom are discussed. (auth)

35218 EFFECTIVE Z VALUES FOR WAVE FUNCTIONS IN MULTI-ELECTRON ATOMS AND THEIR APPLICATION TO THE CALCULATION OF SHAKE-OFF PROBABILITY. Tankhiwale, A. V. (Inst. of Science, Nagpur, India); Mande, C. J. Phys., B (London); 3: 774-7(Jun 1970).

In a multielectron atom, as shown previously by Mande and Damle (1965 and 1966), the interelectronic interaction can be accounted for in the orbital energies by introducing a single screening parameter. It has been shown in this paper that, using the effective-Z values for the energies, the effective-Z values for wave functions of hydrogen-like orbitals can be determined. The hydrogen-like wave functions thus obtained are found to be close to the wave functions given by Herman and Skillman (1963), specially for the 1s, 2s, and 2p orbitals. The present wave functions can be employed to calculate the shake-off probability in the K shell following the β-decay process. The calculated value of the shake-off probability for yttrium is found to agree fairly well with the experimental and theoretical results obtained earlier by other workers. (auth) (UK)

35219 FINITE BASIS, IDEMPOTENT MATRIX, REPRESENTATIVES OF THOMAS–FERMI DENSITIES. Lamers, Guillermo Bernard. Washington, D. C.; Georgetown Univ. (1969). 561p.

Thesis.

The philosophy guiding this work was to obtain quantum-mechanical densities without the numerical labor of full-fledged Hartree–Fock calculations, which should be more reliable, but computationally as straightforward, as those derived by statistical means. The method presented involves an idempotency variational approach, in which the density matrix for the quantum system is forced to be idempotent while it is simultaneously constrained to satisfy the Thomas–Fermi differential equation. As a sample calculation, the helium atom was chosen. The results seem to suggest that the method outlined could be fruitfully employed to significantly improve a large portion of the existing statistical calculations. The actual written material in the thesis consists of two distinct parts. In the first part a more or less comprehensive review of many-body Theory is presented. The second part describes the research inherent in this work; calculations, graphs, and computer programs, as well as suggestions on how the presented calculations can immediately be improved and extended are discussed. (TSS) (Disser. Abstr. Int., B)

35220 ELECTRIC MULTIPOLE RADIATION OPERATOR. Krutov, V. A.; Savushkin, L. N. (Leningrad State Univ.). Zh. Eksp. Teor. Fiz.; 58: 1744-7(May 1970). (In Russian).

Emission by a multipole of the electric type is considered without making recourse to the long-wavelength approximation. The analysis is carried out for quantum transitions of spin-½ charged particles described by the Dirac equation. Corrections to the long-wavelength approximation are calculated for the particular case of x rays from heavy atoms. The corrections are quite large for Z = 92. (auth)

Cosmic Radiation

Refer also to abstracts 35291, 35604, 35605, and 35636.

35221 RADIAL GRADIENTS AND ANISOTROPIES OF COSMIC RAYS IN THE INTERPLANETARY MEDIUM. Fisk, L. A. (Goddard Space Flight Center, Greenbelt, Md.); Axford, W. I. Solar Phys.; 12: 304-16(May 1970).

Approximate equations that describe the behavior of cosmic rays in the interplanetary medium under suitable conditions are used to make comparisons between observations and theoretical predictions of radial gradients and radial anisotropies. In the high-energy region there appear to be no inconsistencies between theory and observations. In the low-energy region it is shown that theoretical predictions of the radial anisotropy expected from large radial gradients of the intensity are not inconsistent with observed radial anisotropies. However, in the latter case, there are other inconsistencies that suggest that some aspects of the observations or of the theory (or both) are unsatisfactory. (auth)

35222 BEHAVIOR OF COSMIC RAYS IN THE INTERPLANETARY MEDIUM. Fisk, Lennard Ayres Jr. San Diego, Calif.; Univ. of California (1969). 206p.

Thesis.

Several features of the behavior of cosmic-ray particles in the interplanetary medium are discussed, including: (i) behavior of the anisotropy during solar cosmic-ray events in terms of a simple model in which the cosmic-ray particles propagate along the mean interplanetary magnetic field, undergoing pitch-angle scattering; (ii) solution of the time-dependent Fokker–Planck equation that governs particle behavior during a model solar cosmic-ray event allowing for convection, diffusion, and energy changes; (iii) equations governing the solar modulation of galactic cosmic rays allowing for convection, diffusion, and energy changes approximated with simpler, more manageable equations that describe the particle behavior in a limited energy range; (iv) approximate equations that should be valid at energies below 50 to 75 MeV/nucleon (provided that $\nabla r/r \gtrsim 3$) determining the anisotropy directly from observations of the spectrum; (v) numerical solutions to the Fokker–Planck equation governing the solar modulation of galactic cosmic rays allowing for convection, diffusion, and energy changes; (vi) some simple solutions to the Fokker–Planck equation governing cosmic-ray behavior in the interplanetary medium that demonstrate that cosmic-ray particles may be accelerated at a shock transition at the outer boundary of the solar wind cavity; and (vii) similarity solutions of the time-dependent Fokker–Planck equation for the cosmic-ray number density that allows for convection, diffusion, and energy changes that illustrate the behavior of cosmic rays during Forbush decreases and energetic storm–particle events. (TSS) (Diss. Abstr.)

35223 ISOTOPIC COMPOSITION OF PRIMARY COSMIC RAY NUCLEI. Lund, N. (Danish Space Research Inst., Copenhagen); Peters, B.; Cowsik, R.; Pal, Y. Phys. Lett.; 31B: 553-6(13 Apr 1970).

A table showing the relative abundance of chemical elements in the primary cosmic radiation, when constructed by measuring the flux of particles which exceed a given magnetic rigidity, differs from a table constructed by measuring the flux of particles which exceed a given velocity; the difference is a known function of the charge to mass ratio of the various components. Using this effect information on the isotopic composition of the elements Be, B, C, N, O, Ne, Mg and Si in the rigidity region above ~5 GV was obtained. (auth)

35224 PERIODIC VARIATIONS OF THE COSMIC RADIATION. I. Messerschmidt, W. (Martin-Luther-Univ., Halle, Ger.). Planet. Space Sci.; 18: 509-24(Apr 1970).

Since 1957, measurements of the cosmic radiation have been carried out by different instruments at Halle (φ = 51.48°, λ = 11.97°) and Lindau (φ = 51.60°, λ = 10.10°). The measurements include an energy spectrum (maxima of the energy distribution) from 5 to 75 GeV. The data were corrected by the pressure coefficient. It was interesting to investigate the periodic variations of the cosmic radiation during the last period of solar activity. The 11-yr variation was registered by all instruments, except the underground one. The yearly course, caused by the temperature effect, is evident at all instruments, measuring mesons. The underground values are phase shifted to times 3 hr earlier. The daily period was gained by forming an average of the values of the individual years. While the characteristic course has been obtained during the eleven years at all instruments at ground level, the underground ones show remarkable alterations. These are due to larger phase fluctuations of the position of the maximum of the daily period. The harmonic analysis was carried out for the 1st and 2nd harmonic. The amplitude of the daily period decreases during the time interval of the observations. At the neutron monitors, the position of the maximum shows only small variations, whereas at the other instruments, the maximum is shifted to earlier hours. The importance of the 2nd harmonic of the daily period is discussed. Underground the 2nd harmonic is relatively large. (auth) (UK)

35225 A NEW COMPONENT OF COSMIC GAMMA RAYS NEAR 1 MeV OBSERVED BY THE ERS-18. Vette, James I.

(Goddard Space Flight Center, Greenbelt, Md.); Gruber, Duane; Matteson, James L.; Peterson, Laurence E. Astrophys. J.; 160: L161-70(Jun 1970).

A NaI omnidirectional scintillation counter 7.65 cm long and of 6.35 cm diameter with a 1-cm plastic scintillation anticoincidence shield aboard the Environmental Research Satellite 18 measured counting rates due to γ rays in space. These rates, uncorrected for efficiency, are 0.94 counts $(cm^2\ sec\ MeV)^{-1}$ in the energy-loss range 0.25 to 0.6 MeV; 0.29 from 0.6 to 1.0 MeV; 0.14 from 1.0 to 2.0 MeV; 0.053 from 2.0 to 3.7 MeV; and 0.036 over the range 3.7 to 6.0 MeV. The actual photon flux in these energy ranges will be a factor of 1.5 to 3 higher, depending on the energy and the assumed photon spectrum at higher energies. Evidence based on known mechanisms of γ-ray production in the 8 g cm^{-2} of satellite material, comparison of the spectra with the shield anticoincidence on and off, and the lack of correlation with solar modulation of cosmic rays all indicate that the measured γ rays were indeed cosmic. The spectrum above 1 MeV lies considerably above the extension of the diffuse cosmic-background x-ray spectrum as determined by Ranger III and other experiments. This suggests an additional galactic or cosmic γ-ray component above that usually accounted for by intergalactic electrons scattering on the 3°K radiation. (auth)

35226 LIMITS ON MAGNETIC MONOPOLE FLUXES IN THE PRIMARY COSMIC RADIATION FROM INVERSE COMPTON SCATTERING AND MUON-POOR EXTENSIVE AIR SHOWERS. Osborne, W. Z. (Manned Spacecraft Center, Houston, Tex.). Phys. Rev. Lett.; 24: 1441-5(22 Jun 1970).

Flux limits for monopoles in the primary cosmic radiation are derived on the basis of muon-poor air-shower data and the analog of inverse Compton scattering of monopoles from universal microwave background photons. Calculations on both galactic and universal scales were performed. The resulting limits are generally smaller than existing experimental limits and are applicable to strongly interacting monopoles. (auth)

35227 CALCUL DES DOSES DE RADIATIONS DANS L'ESPACE. (Caculation of Radiation Doses in Space). Conference Held in Toulouse, France, February 21-23, 1968. Elbaz, C.; Faugere, J.-F.; Lebeau, A. (eds.). Toulouse; Comptes Rendus des Journees Europeennes (1968). 399p. (In French and English). (CONF-680219).

Separate abstracts were prepared for the 23 included papers. (M.O.W.)

For abstracts of individual papers see: 33905, 33981–33987, 35109, 35110, 35228, 35229, 35243, 35283–35290, 35526, and 35592.

35228 COSMIC-RAY CUTOFF ENERGY AT SYNCHRONOUS DISTANCE. Martinides, H.; Taroni, A. (ESTEC, Noordwijk, Netherlands). pp 117-28 of Calcul des Doses de Radiations dans l'Espace. Elbaz, C. (ed.). Toulouse; Comptes Rendus de Journees Europeennes (1968).

From Calculation of Radiation Doses in Space Conference, Toulouse, France. See CONF-680219.

The high-energy particle environment of a synchronous satellite is determined by the flux of high-energy solar particles and the cosmic rays and further by the geomagnetic cutoff energy. This threshold energy is a function of the direction of the arriving particle and the position of the satellite within the magnetosphere. Particles with energies below the cutoff energy are excluded by the action of the geomagnetic field. The geomagnetic cutoff energy for synchronous distance was computed by the trajectory-tracing method, employing the magnetospheric model of Beard and Mead. This model includes the effect of the interaction of the solar wind with the geomagnetic field, which causes the formation of the boundary of the geomagnetic field. This effect is not accounted for in the theory of Stoermer. The method of computation is outlined and typical results obtained by this method are discussed. These results are compared with the theory of Stormer. (auth)

35229 METHODS OF SIMULATING SPACE NUCLEAR RADIATION ON THE GROUND. VALIDITY OF SIMULATION AND EQUIVALENCE OF THE RADIATION EFFECT. Pigneret, J.; Samuell, J. J.; Sarazin, A. (Faculte des Sciences, Lyon). pp 341-67 of Calcul des Doses de Radiations dans l'Espace. Elbaz, C. (ed.). Toulouse; Comptes Rendus de Journees Europeennes (1968). (In French).

From Calculation of Radiation Doses in Space Conference, Toulouse, France. See CONF-680219.

The different types of possible particle sources are analyzed (accelerators, generators, sources, cells), their operating principles, their scale of energy and intensity, and the technics of stabilization, and lastly, the methods of production by nuclear reactions. Furthermore, the methods used for dosimetry are indicated, as well as problems set by exposure of large-size samples. An analysis was made of the simulation validity in a laboratory and the equivalence of radiations: spectral problems, delivery time, flux isotropy, additivity effects. Finally, a survey of the help that may be brought by the models is exposed. (auth)

35230 INTERPRETATION OF COSMIC X-RAY AND GAMMA SPECTRA. Trombka, J. I. (Goddard Space Flight Center, Greenbelt, Md.). Nature (London); 226: 827-8(30 May 1970).

Breaks in the slope of measured diffuse x-ray and gamma-ray cosmological background spectra have been observed, and theoretical models have been proposed to explain such changes. It is pointed out, however, that the changes in slope may be explained partially by the measurement process. The measured pulse heights reported are not identical with the true photon spectra since the response of a real crystal detector to a delta-function pulse-height spectrum is not a delta-function pulse-height spectrum, but is a characteristic continuous response function describing the energy imparted to the crystal; before comparing theory with experiment, the detector effects should be eliminated from the spectra. This is examined for an incident monoenergetic gamma ray incident on an NaI(Tl) detector, applying Shannon's sampling theorem, and some illustrations are presented showing the nature of the problem and solutions that can be obtained. A method is developed to determine both the pulse-height spectrum from a known photon spectrum and the photon spectrum from a measured pulse-height spectrum; information derived from these two spectra differs significantly. The technique for deriving the photon spectra from the measured pulse-height spectra eliminates the effects of instrumental response, and allows meaningful comparison with data from different detectors. (UK)

35231 INVESTIGATION OF ENERGY SPECTRUM OF PRIMARY COSMIC PARTICLES WITH HIGH AND SUPERHIGH ENERGIES ON SPACE STATIONS PROTON. Grigorov, N. L.; Nesterov, V. E.; Rapoport, I. D.; Savenko, I. A.; Skuridin, G. A. (Moscow State Univ.). Yadern. Fiz.; 11: 1058-69(May 1970). (In Russian).

Results are presented on measured proton energy spectra in the energy interval 10^{10} to 10^{13} eV, and on measured spectra of all the primary cosmic particles in the energy interval 10^{10} to 10^{14} eV. The measurements were performed outside the atmosphere on the space stations "Proton-1," "Proton-2" and "Proton-3." The spectrum of all the particles is a power of energy throughout the interval. The proton spectrum becomes steeper at energies 10^{12} to 10^{13} eV. (auth)

35232 SOLAR X-RAY AND DIFFUSE COSMIC X-RAY SPECTRA MEASURED WITH A SATELLITE-BORNE INSTRUMENT. Cunningham, C. (Univ. of California, Livermore); Groves, D.; Price, R.; Rodrigues, R.; Swift, C.; Mark, Hans. Astrophys. J.; 160: 1177-83(Jun 1970).

On August 7–8, 1967 the spectrum and intensity of the solar x-ray flux and the diffuse cosmic x-ray flux were measured. An instrument using an NaI(Tl) scintillation spectrometer as the detector was carried aboard an Air Force polar-orbiting satellite. The instrument recorded the flux of x rays with energies between 2.6 and 19 keV. The Sun was relatively quiet, and solar x rays were detected only between 2.6 and 9.8 keV. If a bremsstrahlung spectrum is assumed, the intensity in this interval varied between 1.3 and 3.1×10^{-5} erg cm^{-2} sec^{-1}. The temperature varied between 8.5 and 12.5×10^6 °K, and the emission measure $N_e N_i V$ varied between 3.5 and 1.7×10^{47} cm^{-3}. Comparisons are made with similar data published by Hudson et al. It is shown that the data and Hudson's are consistent with a decrease of emission measure with increasing temperature during a flare. It was found that the diffuse cosmic x-ray spectrum was closely approximated by $N(h\nu) = 21\ (h\nu)^{-1.95}$. The total intensity observed between 2.6 and 19 keV was 9.8×10^{-8} erg cm^{-2} sec^{-1} $sterad^{-1}$. (auth)

35233 EFFECTIVE GEOMAGNETIC THRESHOLD AND PENUMBRA OF COSMIC RAYS IN IONOSPHERIC COSMIC LAYER. Velinov, P. (Inst. of Geophysics, Sofia). Compt. Rend. Acad. Bulg. Sci.; 23: 153-6(1970).

Expressions for electron production in the ionosphere cosmic-ray layer and for the effective geomagnetic rigidity threshold are described. (M.O.W.)

35234 SOLAR COSMIC-RAY PROPAGATION. Barouch, Eleazar (CEN de Saclay, Gif-sur-Yvette, France). Compt. Rend., Ser. B; 270: 973-6(13 Apr 1970). (In French).

The interaction of the solar cosmic rays with the interplanetary shock waves is studied. The resulting model is in good agreement with the experimental data. (France)

Direct Energy Conversion

35235 (IPP-3/104) MEASUREMENTS OF THE POTENTIAL AND CURRENT DENSITY DISTRIBUTIONS IN A SIMULATED FARADAY-TYPE MHD GENERATOR WORKING WITH ARGON-POTASSIUM PLASMA. Burger, J. (Institut fuer Plasmaphysik, G.m.b.H., Garching (West Germany)). Dec 1969. 69p. (In German). Dep. CFSTI (U. S. Sales Only).

The efficiency of an MHD generator depends on the current distribution in the generator duct. The current distribution in Faraday-type MHD generators has been determined theoretically and experimentally by various authors. There are, however, discrepancies between the calculated and measured distributions. Here, potential distributions were measured with movable electrostatic probes in the generator duct to provide information about the relevant current distributions. The measuring method is based on the fact that the current direction can be determined from the relation cotan $\Theta' = \beta$ when the Hall parameter β and the lines of constant ψ^*-potential are known; Θ' gives the angle between the current direction and the lines $\psi^* = \text{const}$. It was possible to determine the current lines and also the regions in which the current of the individual electrode pairs flows. Furthermore, the potential measurements allowed the approximate values of the electrode falls to be determined. The measurements were made in a potassium seeded argon plasma (c = 0.3%). The gas temperature was 2000°K, the gas pressure 1 atm, and the flow velocity in the range of 55-115 m/sec. The maximum intensity of the applied magnetic field was 1.5 tesla. Parallel to the induced emf an additional electric field was applied separately to each of the nine pairs of electrodes. The average current density was in the range of 0.1 to 1.7 amp/cm^2. The ψ^* potential distribution could be determined by measuring the probe potential relating to an electrode and taking into account the distribution of the open circuit potential. The values of the Hall parameter were measured elsewhere under equivalent plasma conditions. Since, however, field fluctuations due to ionization instabilities occur in the entire duct region at current densities exceeding 100 mA/cm^2 and magnetic fields exceeding 0.3 tesla, a saturation value of the Hall parameter had to be used in almost the entire measuring range. Measurements of the spatial distribution of these field fluctuations show under certain conditions strong local variations of the amplitudes, thus indicating that the circular currents causing the ionization instabilities may be limited to small regions and can vary locally a great deal. The determined current distributions could be compared with calculated results. Qualitative agreement was found, especially with regard to relaxation effects. But there were also significant deviations: the measured downstream current component in the center of the channel under periodic conditions is not as large as predicted by the theory; and the potential and current distributions in regions near the cathodes are much more uniform. This behavior could be explained qualitatively by the special discharge mechanism at the cathode, which was not treated in the calculations. (auth)

35236 GIDRAVLIKA MAGNITOGIDRODINAMICHESKIKH MASHIN. (Hydraulic Magnetohydrodynamic Machines). Tananaev, A. V. Moscow; Atomizdat (1970). 272p.

Theoretical and experimental data are given on hydraulic properties of MHD generators operating with liquids. Design, construction, and operation of MHD generators are discussed, considering the flow in the tubes and in the boundary layer, fluid flow in hydraulic system elements, influence of magnetic field on the flow in tubes and on the boundary layer. Experimental installations, models, and measurement methods are discussed. (R.V.J.)

35237 EFFECT OF SLOTS ON MHD INDUCTION GENERATOR EFFICIENCY. Elliott, D. G. (California Inst. of Tech., Pasadena). Energy Convers.; 10: 73-4(Apr 1970).

The reduction in induction generator efficiency due to finite number and width of winding slots is calculated by summing the effects of the resulting harmonics. For a 300-kW lithium generator the efficiency is reduced by 30, 10, and 3 percentage points with 6, 12, and 24 slots (3, 6, and 12 phases), respectively. (auth) (UK)

35238 EFFECT OF AIR/FUEL LEVEL IN THE MHD GENERATOR ON THE OPERATION OF AN OPEN-CYCLE MHD-TOPPED POWER PLANT. Feldmann, H. F.; Simons, W. H.; Bienstock, D. (Bureau of Mines, Pittsburgh). Energy Convers.; 10: 89-91(Apr 1970).

Operation of an MHD generator at below stoichiometric air/fuel ratios is compared with that at a 5% excess air level. At the below-stoichiometric air levels, combustion is completed by injecting additional air downstream of the MHD generator. Major advantages pointed out for operating the MHD generator below the stoichiometric air levels are increased power densities and reduced air pre-heat temperatures without loss of overall plant thermal efficiency. (auth) (UK)

35239 REPLENISHMENT OF ELECTRODES FOR MHD POWER GENERATION. Warren, A. C.; Meier, P. G. (Central Electricity Research Labs., Leatherhead, Eng.). Energy Convers.; 10: 93-7(Apr 1970).

The replenishment of zirconia MHD electrodes directly from a plasma was investigated both in open flame and duct configurations. The zirconia deposited only on the electrodes and the rate of deposition was a function of injected zirconia particle size and distance along the duct. The results may be adequately explained if it is assumed that the deposition occurs by molecules subliming from the injected particles and condensing on the electrodes but is inconsistent with the view that the particles are deposited directly. (auth) (UK)

35240 EFFECTS OF TEMPERATURE AND VELOCITY PROFILE IN FARADAY-TYPE MHD GENERATOR. Celinski, Z. N. (Inst. of Nuclear Research, Warsaw). Energy Convers.; 10: 105-12(Apr 1970).

The effect of gas velocity and temperature distributions in the channel cross section on the electrical parameters of the Faraday-type MHD generator are considered. The general solution of the problem for the arbitrary distribution functions in the two-dimensional gas flow is very complicated. Such solution may be performed more simply in the numerical way. In order to find simpler expressions for the effects of the non-uniform distribution described by arbitrary functions, the problem is divided into two parts. In the first part, the effects of the non-uniformities in the z axis only (the direction of the magnetic field), are calculated. In the second part the effects of the non-uniformities in the y axis (the direction of the induced electrical field) are calculated. When gas properties vary along the z axis, the circulating currents flow in the cross-sectional area of the channel due to the nonuniform distribution of the gas velocity. These currents induce the Hall circulating currents along the x axis. The ohmic losses due to the circulating currents are independent of the load factor. They are not high, e.g., they are less than 3% of the generated power for the typical distributions. The maximum point of the efficiency curve versus load factor is shifted to the lower values of the generator loading. The terminal voltage and generated power increase slightly; the internal resistance does not change in sufficient manner in comparison to the constant gas property generator. The weak Hall fields can be induced at the open circuit conditions of the generator due to the nonuniform distribution of the Hall parameter. When gas properties vary in the y axis, the strong Hall current flows in the x axis. These currents deteriorate the electrical performance of the generator. The parameter A, which characterizes this deterioration, is determined. The decrease of the electrical terminal values may be strong, especially in the case when the magnetic induction is high. The parameter A is proportional to B^2 and depends on the distribution functions of the gas conductivity and of the Hall parameters. The distribution of the electrical parameters in the y axis (current density, electrical potential, electrical field) becomes more nonuniform with increasing B. (auth) (UK)

35241 EGD ENERGY CONVERTER GEOMETRY STUDIES. France, D. M.; Trezek, G. J. (Univ. of California, Berkeley). Energy Convers.; 10: 99-104(Apr 1970).

Comparison of the performance characteristics, current ratio voltage amplification ratio, and electric power efficiency, of an electrogasdynamic energy converter are presented for three conversion channel geometries: abrupt expansion, divergent, and free jet. Of the three channels investigated, a higher power efficiency was obtained for the jet type flows where solid boundaries in the vicinity of the flow had been removed. Best results were obtained from the abrupt expansion channel due to the further underexpansion of the jet from the free jet case. Experimental results are presented over a range of load resistance up to 10^{11} ohms using air as the working fluid. Maximum voltage amplification ratio of 10 is reported at a peak electrical efficiency of 2.5 for the abrupt expansion channel. Optimum channel length studies on the abrupt expansion and free jet channels suggest that a relation between channel length and resistance at which peak efficiency occurs can be given by $L/d' (R/10^9)^{-B} = K$ where the constants B and K vary with channel geometry. The existing theory for prediction of load current was modified to include a field coefficient. The magnitude of this coefficient was observed to vary with channel geometry. (auth) (UK)

35242 PHYSICAL PHENOMENA IN MAGNETOHYDRODYNAMIC GENERATORS. Titeica, R.; Stoenescu, M.; Lupas, N.

(Inst. of Physics, Bucharest). Rev. Roum. Phys.; 14: 1023-7 (1969).

Some considerations concerning the operation principles and parameters of magnetohydrodynamic generators and their thermal efficiency are presented. The way is shown in which optimum solutions for entrance parameters are to be sought. The values of parameters at entrance and their variation along the conversion channel are given for a laboratory constant-speed model. (auth)

35243 DEGRADATION OF SOLAR GENERATORS IN SPACE AND THE INFLUENCE ON THEIR DESIGN. Daspet, M. H. (CNES, Bretigny, France). pp 261-86 of Calcul des Doses de Radiations dans l'Espace. Elbaz, C. (ed.). Toulouse; Comptes Rendus de Journees Europeennes (1968). (In French).

From Calculation of Radiation Doses in Space Conference, Toulouse, France. See CONF-680219.

Several systems were studied, however, two principal versions are used: the first one is the miniaturization of a solar oven, such as it is conceived on ground. Two inconveniences are to be noted for its use in space: the realization and utilization of a large focusing mirror. The second is by using semiconductor devices converting directly the incident electromagnetic radiation into electrical energy without any focalization or concentration subsystem. (auth)

35244 PULSED MHD ARRANGEMENT STUDY FOR UTILIZING NUCLEAR POWER. Schuart, L. (Technische Hochschule, Magdeburg, Ger.). Kernenergie; 13: 69-75(Mar 1970). (In German).

The well-known MHD arrangements using liquid metals as the working fluid show very low efficiency. A pulsed MHD arrangement was therefore studied, hoping for high efficiency from the viewpoint of thermodynamic analysis. The possibilities of realizing the process were examined, and the course of the process was calculated for various versions. It is shown that, by utilizing this process, a considerable gain in the efficiency of nuclear power plants may be obtained. But development and investment costs seem to be too high for justifying the use of such arrangements. (auth)

35245 RECOMBINATION COEFFICIENTS IN A DENSE WEAKLY IONIZED CESIUM PLASMA. Bekmukhambetov, E. S.; Kanatchinov, A. K. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat., No. 6, 71-6(Nov.-Dec. 1968). (In Russian).

The mechanism of recombination in dense weakly ionized cesium plasma is analyzed. The value of the recombination coefficient is calculated for a cesium arc in the low-voltage regime of a thermionic converter. The calculations are compared with experimental data. (tr-auth)

Fluid Physics

35246 MAGNETOHYDRODYNAMIC BELTRAMI FLOWS. Rudraiah, N. (Bangalore Univ., India). J. Phys. Soc. Jap.; 29: 205-9(Jul 1970).

Magnetohydrodynamic nonsteady Beltrami flow between two infinite parallel walls, with an impressed magnetic field transverse to the walls is discussed. Exact solutions of modified Navier–Stokes equations are obtained, using both Laplace transform and normal mode methods. Expressions for the induced magnetic field and the skin friction are also obtained. Numerical values of velocity, skin friction, and induced magnetic field are calculated for different values of Hartmann number at different times and the results are tabulated and several conclusions are drawn. (auth)

35247 FLOW OF AN ELECTRICALLY CONDUCTING GAS PAST A SLENDER BODY IN THE PRESENCE OF A CROSSED MAGNETIC FIELD. Kusukawa, Ken-ichi (Tokyo Metropolitan Univ.). J. Phys. Soc. Jap.; 29: 224-33(Jul 1970).

The flow of an electrically conducting gas past a slender body of an arbitrary cross section, in the presence of a crossed magnetic field, is dealt with by the magnetohydrodynamic Stokes approximation. Using a concept of the slender-body theory, the perturbation velocity and the induced electric fields are shown to be quasi-two-dimensional. The fields are developed into the power series of a parameter, Q, defined by the product of the magnetic Reynolds number and the pressure number. It is found that the induced electric field without any space charge remains finite even if the parameter, Q, tends to zero, and that in the case of finite value of Q some space charges appear and the flow becomes rotational. (auth)

35248 MAGNETOHYDRODYNAMIC FLOW IN RECTANGULAR DUCTS: AN EXTENSION OF THE HUNT-STEWARTSON APPROACH. Fahidy, T. Z. (Univ. of Waterloo, Ont.). J. Fluid Mech.; 42: 245-8(Jun 1970).

The Hunt–Stewartson technique of estimating fluid velocity and magnetic flux profiles in rectangular ducts is generalized for the entire secondary boundary layer. (auth) (UK)

35249 LAMINAR HYDROMAGNETIC FLOW BETWEEN CONCENTRIC ROTATING CYLINDERS. Lin, Sheng Haiung (Chung Yuan Coll. of Science and Engineering, Chung-Li, Taiwan). Phys. Fluids; 13: 1873-4(Jul 1970).

An analytic solution for the general laminar hydromagnetic flow between concentric rotating cylinders is presented. The general solution agrees with that of the nonmagnetic special case. (auth)

35250 CONTROL OF AN INSTABILITY ON THE FLUID PENDULUM WITH MAGNETIC FEEDBACK. Zrnic, Dusan S.; Hendricks, Charles D.; Crowley, Joseph M. (Univ. of Illinois, Urbana). Phys. Fluids; 13: 1875-7(Jul 1970).

A simple model of Rayleigh–Taylor instability on a fluid pendulum and its stabilization under the influence of magnetic fields with and without feedback are discussed. (auth)

35251 MODEL EQUATIONS FOR MAGNETOHYDRODYNAMIC TURBULENCE: A GAS DYNAMIC ANALOGY. Thomas, John H. (Univ. of Rochester, N. Y.). Phys. Fluids; 13: 1877-9(Jul 1970).

Model equations for magnetohydrodynamic turbulence previously proposed are shown to have an exact analog in gas dynamics. An analytical solution of the initial value problem and certain general results for the equations are presented. (auth)

35252 NONSTATIONARY MAGNETOHYDRODYNAMIC COUETTE FLOW PRODUCED BY VARIATIONS OF APPLIED MAGNETIC FIELDS. Khozhanov, A. I. Izv. Akad. Nauk SSSR, Mekh. Zhidk. Gaza; No. 2, 30-4(Mar-Apr 1970). (In Russian).

Approximate calculations are made for the unsteady flow of viscous conducting fluid propagating between two plates. One of the plates is an ideal conductor moving at a steady rate in its own plane and the other is a stationary insulator plate. The homogeneous magnetic field is perpendicular to both plates. It is assumed that the nonstationary process was induced by instantaneous variations in the applied magnetic field. The obtained formulas are analyzed. (R.V.J.)

35253 STUDIES OF GENERAL PROPERTIES OF MAGNETOHYDRODYNAMIC TURBULENCE IN TUBES BY MEANS OF CONDUCTION ANEMOMETERS. Branover, G. G.; Gel'fgat, Yu. M.; Kit, L. G.; Tsinober, A. B. Izv. Akad. Nauk SSSR, Mekh. Zhidk. Gaza; No. 2, 35-44(Mar-Apr 1970). (In Russian).

The mechanism of damping of turbulence in tubes by magnetic fields is studied, considering that $R_m \ll 1$. Data obtained on MHD turbulence by the spectral theory method are used for determining the characteristic tendencies in damping of heterogeneous disturbances by magnetic fields. The advantageous features of a conduction anemometer for measuring magnetohydrodynamic flow are described. Approximate curves were constructed for the spectral density of damped turbulence. (R.V.J.)

35254 IMPOSSIBILITY OF SOME COINCIDENCES IN MAGNETO-FLUID-DYNAMICS. Singh, Bijai; Ram, Rishi (Banaras Hindu Univ., India). Ann. Soc. Sci. Brux. Ser. I; 84: 175-84 (25 May 1970).

A pseudo-stationary flow of an ideal conducting gas downstream a shock wave is discussed. By applying the first-order compatibility condition for a singular surface, the basic equations governing the pseudo-stationary flow are transformed into normal forms. The jumps of vorticity and current density across three types of hydromagnetic shocks are determined. Assuming the flow upstream from the shock to be uniform, the expressions for vorticity and current density generated by these shocks are obtained in terms of quantities associated with shock geometry and the conditions on the upstream flow. Finally, the impossibility of the coincidence of vortex lines with pseudo-stream lines and that of current lines with magnetic lines is discussed in magnetohydrodynamic flow behind perpendicular, parallel, and switch-off hydromagnetic shocks. (auth)

Geophysics (Upper Atmosphere)

Refer also to abstracts 35089, 35103, 35116, 35178, 35228, 35440, and 35465.

35255 (AD-701640) RESEARCH DIRECTED TOWARD EVALUATION OF RADIATION ENVIRONMENT OF NEAR-EARTH SPACE. Final Report, June 17, 1968-December 15, 1969. Arnoldy, Roger L. (New Hampshire Univ., Durham. Dept. of Phys-

ics). Contract F19628-68-C-0294. 38p. (AFCRL-70-87). CFSTI.

As a result of the correlation study of the sudden intensity increases seen by the ATS-1 electron spectrometer with the occurrence of magnetic substorms the following conclusions are reached: (1) Electrons are produced in the 50 to 150-keV energy range as observed at 6.6 R_E during a magnetic substorm. (2) The electrons are produced at or near the midnight meridian and then drift on closed field lines aroung the Earth. (3) The electron bunch produced as a result of the substorm in 75% of the 60 events studied is associated with precipitation observed by riometers as it drifts. (4) The frequency of occurrence of such particle substorms indicates that they might represent a quasi-steady source of electrons for the trapped radiation. Rapid fluctuations in the intensity of precipitated energetic particles during a bright aurora were studied. The fluctuations occurred only during the period of peak precipitation and in close correlation with the westward surge of a bright auroral band preceding breakup. Dynamic spectral analysis of the data showed no sustained periodicities. (auth) (USGRDR)

35256 CHARACTERISTICS OF A VISUAL AURORA FOLLOWING A SOLAR FLARE. Meriwether, J. W. Jr. (Univ. of Maryland, College Park); Benesch, W. M.; Tilford, S. G. Planet. Space Sci.; 18: 525-34(Apr 1970).

On February 13, 1967 at 1746 UT, the brightest flare of that year erupted from the surface of the Sun. Approximately 56 hr later, the sudden commencement of a magnetic storm was recorded by many observatories around the world. Midway between the worldwide sudden commencement and the termination of the magnetic storm, there occurred at Ft. Churchill an aurora attaining nearly IBC III and an accompanying local negative magnetic bay. Measurements were made on this aurora as one of a series investigated with a multiple channel photometer simultaneously recording ten wavelength bands. The aurora of February 16 appeared normal under casual observation, but a detailed examination of its emission structure has turned up a number of deviations from other auroras studied. Highlights of these include an unusual amount of λ6300 intensity and an increase in the apparent vibrational temperature of the molecular nitrogen that correlates well with the increase in the λ6300 emission. It is concluded that the magnetic storm is primarily responsible for these unusual effects. (auth) (UK)

35257 THERMAL DIFFUSION IN THE F2 REGION OF THE IONOSPHERE. Schunk, Robert W.; Walker, James C. G. (Yale Univ., New Haven). Planet. Space Sci.; 18: 535-57(Apr 1970).

In order to examine the effects of thermal diffusion of F2-region ion densities, ordinary and thermal diffusion coefficients were evaluated to the second approximation of Chapman and Cowling (1958) for a partially ionized atomic oxygen plasma. Results show that the thermal ambipolar diffusion coefficient, like the ordinary ambipolar diffusion coefficient is not significantly affected by the electrons. Its value is determined almost entirely by ion–neutral interactions. The steady-state continuity equation of the oxygen ions was solved for typical midlatitude daytime conditions and it was found that thermal diffusion acts to reduce the ion density at 600 km by 24%. At altitudes above 300 km diffusion of the minor ions, H^+, He^+ and N^+ is not influenced by the neutral species, and the ordinary and thermal diffusion coefficients of these ions may be evaluated for a fully ionized plasma. The solutions of the continuity equations of these ions show that, at 700 km, the effect of thermal diffusion is to reduce the density of H^+ ions by 46%, to reduce the density of He^+ ions by 22%, and to increase the density of N^+ ions by more than a factor of 2. (auth) (UK)

35258 DENSITY OF O^{2+} IONS IN THE TOPSIDE IONOSPHERE. Walker, James C. G. (Centre National d'Etudes des Telecommunications, Issy-les-Moulineaux, France). Planet. Space Sci.; 18: 559-64(Apr 1970).

Over a significant range of altitude in the topside ionosphere the drift velocity of O^{2+} ions is controlled by the motion of the dominant O^+ ions because the diffusion coefficient is too small to permit the doubly-charged ions to diffuse relative to the ambient plasma. Since it is not very likely that chemical recombination of O^{2+} ions is important at these heights the O^{2+} density is determined simply by the rate of photoionization of O^+ ions and by the ambipolar diffusion velocity of the O^+ ions. It is therefore possible to calculate O^{2+} densities in the topside ionosphere without knowledge of the chemical loss rates, provided that these are not very large. Illustrative calculations show that the O^{2+} density increases slowly with altitude and that the ratio of O^{2+} to O^+ is about 1 per cent at 500 km. (auth) (UK)

35259 EQUATORIAL ELECTROJET AS SOURCE OF LONG-PERIOD TRAVELLING IONOSPHERIC DISTURBANCES. Chimonas, G. (Univ. of Toronto). Planet. Space Sci.; 18: 583-9(Apr 1970).

The equatorial electrojet is considered as a possible source of low-frequency TID's. Calculations are made to investigate the shape and strength of such disturbances which may be launched through the Lorentz coupling of the electrojet to the neutral atmosphere. It is concluded that such coupling is very much weaker in the equatorial region than is the case at auroral latitudes. An order of magnitude comparison of the Lorentz, and Joule heating, coupling strengths indicates that the former dominates the TID generation except perhaps in the most severe storms. (auth) (UK)

35260 ATMOSPHERIC GRAVITY WAVES LAUNCHED BY AURORAL CURRENTS. Chimonas, G.; Hines, C. O. (Univ. of Toronto). Planet. Space Sci.; 18: 565-82(Apr 1970).

Auroral currents have been recognized in the past both theoretically and observationally, as a probable source of atmospheric gravity waves and of associated travelling ionospheric disturbances (TID's). A model calculation is performed here, by which the magnitude and form of the anticipated atmospheric wave train may be assessed. Both are found to be consistent with observations already recorded. The question, as to whether the Lorentz force or the Joule dissipation is the more important exciting agency provided by the current, is left unanswered because of present uncertainties connected with the nature of the current itself. (auth) (UK)

35261 BOW WAVE GENERATED BY AN AURORAL ARC IN SUPERSONIC MOTION. Chimonas, G.; Peltier, W. R. (Univ. of Toronto). Planet. Space Sci.; 18: 599-612(Apr 1970).

The mechanism through which infrasound is generated by the supersonic translation of auroral electrojet currents is investigated quantitatively. For the case in which the entire arc is in uniform lateral motion it is found that the pressure pulse received at the ground can give a quantitative description of the currents flowing along the arc. Using a somewhat simplified adaptation of this approach magnitudes are obtained for the arc currents required to explain the infrasound records obtained by Wilson (1969a). The total arc current so obtained is in good quantitative agreement with that deduced from magnetometer records (Wilson, 1969b). (auth) (UK)

35262 INFRASONIC WAVES GENERATED BY AURORAL CURRENTS. Chimonas, G. (Univ. of Toronto). Planet. Space Sci.; 18: 591-8(Apr 1970).

The infrasonic wave field generated by a pulsating aurora is calculated under both Joule heating and Lorentz force coupling conditions. It is found that either may give rise to a field of magnitude detectable with ground based apparatus placed within several hundred kilometers of the aurora's latitude. These results are compared with a previous calculation that obtained the erroneous conclusion that the field would be strongly confined to the region directly below the aurora. (auth) (UK)

35263 AURORAL PULSATIONS: TELEVISION IMAGE AND X-RAY CORRELATIONS. Scourfield, M. W. J.; Cresswell, G. R.; Pilkington, G. R.; Parsons, N. R. (Univ. of Calgary, Alberta). Planet. Space Sci.; 18: 495-9(Apr 1970).

The association between auroral x-rays and luminosity has been studied for pulsating auroras by coordinated observations with a balloon borne x-ray detector and a ground based image intensifier-television system viewing the N_2^+ ING emissions. The degree of correlation between x-ray and luminosity variations was found to depend upon the number of pulsating forms common to both detector fields of view. Correlation was good in those cases when one form occupied the optical field of view but poor when several, asynchronously pulsating, forms were present. (auth) (UK)

35264 AURORAL OVAL AND THE BOUNDARY OF CLOSED FIELD LINES OF GEOMAGNETIC FIELD. Feldstein, Ya. I. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow); Starkov, G. V. Planet. Space Sci.; 18: 501-8(Apr 1970).

A comparison of the position of the auroral oval with the boundary of the stable trapping region ϕ_t and the limit of closed geomagnetic field lines ϕ_c was carried out; Alouette-2 data are used to obtain the trapping boundary. In the midnight hours ϕ_t coincides with equatorward boundary of the auroral oval, and in the midday hours ϕ_c is situated within the oval. The equatorward boundary of the auroral oval is closely connected with the position of the region, in which the geomagnetic field lines are closed, regardless of the degree of magnetic activity. The values of ϕ_c on the day of the Earth changes with universal time. It is suggested that the change is caused by the variation of the orientation of geomagnetic axis with respect to the streaming solar wind around the magnetosphere. (auth) (UK)

35265 INFLUENCE OF THE FORBUSH EFFECTS ON THE STATE OF THE COSMIC-RADIATION LAYER IN THE LOWER IONOSPHERE. Velinov, P.; Dorman, L. I.; Nesterov, G. (Geo-Physical Inst., Sofia. Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Academgorodok, USSR). Dokl. Akad. Nauk SSSR; 190: 1063-5(11 Feb 1970). (In Russian).

Cosmic rays of galactic origin form an independent layer with an electron density of about 10^2 cm^{-3} at altitudes of 50 to 80 km in the lower ionosphere. The influence of Forbush effects on this layer was investigated, taking the influence of other factors such as solar x- and ultraviolet radiation, into account. For this reason the measurements were carried out during the night when the relative effect of the galactic cosmic radiation is highest, at the frequency of 155 kHz at the Sofia–Brasov (Romania) 370-km long radio track. The data concerning the variation of cosmic rays on the basis of the absorption of radiowaves obtained during the period from April 25 to May 12, 1960, were analyzed. It was found that the variation of the rate of formation of electrons in the cosmic radiation layer is determined by the balance of the simultaneous action of the geomagnetic variation and the extra-terrestrial changes of cosmic radiation. The influence of magnetic storms and of the Forbush effects was also taken into account. (TTT)

35266 LONGITUDINAL AND TRANSVERSE ELECTRIC FIELD EFFECTS IN MAGNETOSPHERIC PRECIPITATION. Catchpoole, J. R. (Univ. of Queensland, St. Lucia, Australia). Aust. J. Phys.; 23: 155-9(Apr 1970).

A comparison is made of changes in the spectra of the electron precipitation out of magnetospheric trapping, separately brought about by two distinct mechanisms; namely, the superposition of a longitudinal electric field, and trapped-particle drift into a region of different electric potential. (Australia)

35267 REACTIONS IN THE IONOSPHERE. Bates, D. R. (Queen's Univ., Belfast). Contemp. Phys.; 11: 105-24(Mar 1970).

The ion chemistry of the E and F layers depends on a few ion–neutral reactions, with NO^+ as the terminating ion, and on dissociative recombination. In the topside ionosphere, the main source and sink of the H^+ ions is the reversible charge-transfer process $H + O^+ \rightleftharpoons H^+ + O$; the He^+ ions are formed by the action of solar radiation and are neutralized in dissociative charge-transfer collisions with nitrogen molecules. The metallic positive ions present in sporadic E and in the D region result from photoionization and charge transfer. It is not certain how they recombine. Positive ions in the middle and lower part of the D region take part in a sequence leading to the hydrated protons $H_3O^+(H_2O)_n$ observed. Negative ions are here important but little can be said with assurance about their nature. (auth) (UK)

35268 FULL-WAVE STUDIES OF THE IONOSPHERIC REFLECTION COEFFICIENTS OF VLF AND LF RADIO WAVES. Wand, I. C.; Jones, T. B. (Univ. of Leicester, Eng.). J. Atmos. Terrest. Phys.; 32: 737-56(May 1970).

A full-wave method was used to calculate the reflection and conversion coefficients of several model ionospheres for radio waves in the frequency range 15 to 70 kHz propagated in a number of azimuthal directions at angles of incidence ranging from 0 to 90°. Three types of ionospheric models were considered: (a) simple exponential variations of electron density with height and constant electron collision frequency, (b) an exponential electron density distribution and a collision frequency which varies with height, and (c) typical experimentally derived height variations of both electron density and collision frequency. (auth) (UK)

35269 MATHEMATICAL MODEL FOR THE MAGNETOSPHERE. Hewson-Browne, R. C.; Burghes, D. N. (Univ. of Sheffield, Eng.). J. Atmos. Terrest. Phys.; 32: 757-65(May 1970).

A possible mathematical model for the interaction of the solar wind with the geomagnetic field is considered. This model includes a neutral point at the front of the magnetosphere and a neutral sheet down stream. The cavity boundary and the field lines inside the cavity are found for various values of the tail flux parameter. (auth) (UK)

35270 WAVE INTERFERENCE AT VLF RESULTING FROM LAYERS OF HEAVY IONS IN THE LOWER IONOSPHERE. Thomas, L. (Radio and Space Research Station, Slough, Eng.). J. Atmos. Terrest. Phys.; 32: 767-74(May 1970).

A full-wave integration method was used to examine the influence on the propagation of vlf waves of heavy-ion layers located at various heights in the lower ionosphere. It is found that marked changes in reflection and transmission coefficients can arise, these changes being composed of reductions at all frequencies and components which oscillate with frequency. These results are explained on the basis of increased attenuation of waves passing through the ion layers, and the interference of waves reflected from the ion layers with waves returned from the main reflection level. (auth) (UK)

35271 DYNAMICS OF THE F REGION OBSERVED WITH THOMSON SCATTER. II. INFLUENCE OF NEUTRAL AIR WINDS ON THE IONOSPHERIC F REGION. Vasseur, G. (CNET/RSR, Issy-les-Moulineaux, France). J. Atmos. Terrest. Phys.; 32: 775-87(May 1970).

In a previous paper (1969) the author described diurnal variations of the meridional component of neutral air winds which were derived from Thomson scatter measurements of ion drifts in the F region. Solutions of the F-layer continuity equation are now presented which take account of the effects of these wind-induced vertical drifts. Various F-region phenomena including the evening enhancement of n_m and the diurnal variation of the height of the F2-layer peak are shown to be associated with neutral air winds. There are some discrepancies between the calculated and observed behavior of the F region which suggest that there is a nighttime ion production source in winter and a seasonal variation of the neutral atmosphere composition. (auth) (UK)

35272 DEPENDENCE OF SATELLITE SCINTILLATIONS ON ZENITH ANGLE AND AZIMUTH. Singleton, D. G. (Australian Defence Scientific Service, Salisbury). J. Atmos. Terrest. Phys.; 32: 789-803(May 1970).

An analysis of experimental data was made to determine the nature of the variation of scintillation index with the zenith angle and azimuth of the direction of propagation at an observing point on the Earth's surface. Scintillation observations of the Beacon Explorer satellites were employed that were made at a number of sites throughout Australasia ranging in geomagnetic latitude from 25° to 50° South. At all sites strong evidence was found for the existence of field-aligned columns and indeed, such irregularities appear to be the main cause of scintillations throughout the latitude range regardless of season or time of day. At the high and low latitude stations, some of the field-aligned columns showed signs of being spread laterally in a direction a little to the east of magnetic north in all seasons. In the middle latitudes this effect is present only in the summer and the equinoxes. During the winter at these latitudes evidence for the existence of field-aligned sheets of large east–west extent is found. An improved understanding was obtained for the relationship between the occurrence of spread-F, deduced from bottomside and topside ionograms, and scintillations, in terms of the observed latitude variation in the shape of the irregularities which produce scintillations. (auth) (UK)

35273 A CORRELATION APPARATUS FOR THE MEASUREMENT OF THE DRIFT IN THE IONOSPHERE BY THE SPACED-RECEIVER METHOD. Vesseur, H. J. A. (Royal Netherlands Meteorological Inst., De Bilt). J. Atmos. Terrest. Phys.; 32: 829-35(May 1970).

An apparatus is described which is used for the evaluation of ionospheric drift by the spaced receiver method. After each measurement of 3 min the auto- and cross-correlation functions are automatically calculated from recorded values of the signs of the departures of the signals from their mean values (the signs of [u(t) – u(t)]: this quantity is called the "polarity" of the recorded signal. It is shown that the results agree well with those calculated by the method of "similar fades." (auth) (UK)

35274 SEASONAL VARIATIONS OF ELECTRON DENSITIES BELOW 100 km AT MIDLATITUDES. III. STRATOSPHERIC-IONOSPHERIC COUPLING. Gregory, J. B.; Manson, A. H. (Univ. of Saskatchewan, Saskatoon). J. Atmos. Terrest. Phys.; 32: 837-52(May 1970).

During the winters of 1963–64, changes in the lower ionosphere were found to be associated with changes in the atmospheric circulation over Christchurch, New Zealand. Selected examples are discussed in detail. Typical increases in electron densities or radio wave absorption are shown to be more strongly related to stratospheric temperature increases than to magnetic activity. Examples are given of ionospheric response to the passage of cyclonic waves ($\lambda \approx 3500$ km) at 200 mb, which were possibly coupled to planetary waves ($\lambda \approx 10{,}000$ km), at 10 mb. Observed ionospheric behavior is compared with predictions of wave propagation, using recent theoretical models and observed mesospheric wind data. Requirements for future studies of the coupling phenomenon are discussed. (auth) (UK)

35275 SIMULTANEOUS SOLUTION OF THE TIME DEPENDENT COUPLED CONTINUITY EQUATIONS, HEAT CONDUCTION EQUATIONS, AND EQUATIONS OF MOTION FOR A SYSTEM CONSISTING OF A NEUTRAL GAS, AN ELECTRON GAS,

AND A FOUR-COMPONENT ION GAS. Stubbe, Peter (Max-Planck-Institut fuer Aeronomie, Lindau, Ger.). J. Atmos. Terrest. Phys.; 32: 865-903(May 1970).

A simultaneous time-dependent solution in the height range from 120 to 1500 km is described of the continuity equations for the ions O^+, O_2^+, NO^+, H^+, of the heat conduction equations for the ions O^+ and H^+, the electrons, and the neutral gas, and of the equations of motion for the west–east and north–south neutral wind velocities. Solutions are presented for the equinoctial midlatitude ionosphere and atmosphere for low, medium, and high solar activity. (auth) (UK)

35276 TRUE-HEIGHT ANALYSIS OF OBLIQUE-INCIDENCE HF RADIO-WAVE DATA. George, P. L. (Australian Defence Scientific Service, Salisbury). J. Atmos. Terrest. Phys.; 32: 905-16(May 1970).

A lamination method of true-height analysis is proposed by which data obtained in oblique ionospheric sounding may be used to derive the electron distribution in the ionosphere remote from the sounding station. The application of the method to forward oblique and ground backscatter data is discussed, and some preliminary results are presented. (auth) (UK)

35277 "LUNAR TIDE IN D REGION" OF THE IONOSPHERE NEAR THE MAGNETIC EQUATOR. Chakravarty, S. C.; Rastogi, R. G. (Physical Research Lab., Ahmedabad, India). J. Atmos. Terrest. Phys.; 32: 945-8(May 1970).

The phase of the lunar tide in the ionospheric absorption at Colombo does not change appreciably with season during low sunspot years but has a semi-annual variation during the maximum sunspot years. Lunar tide in f-min for any particular season of the period IGY/IGC has a phase identical to that of absorption; the amplitude does not show any marked enhancement close to the magnetic equator. (auth) (UK)

35278 LOWER-IONOSPHERIC DRIFT MOTIONS. Iyengar, R. S. (Mount Allison Univ., Sackville, New Brunswick). J. Atmos. Terrest. Phys.; 32: 955-60(May 1970).

Aurorally associated vhf radio signals relating to three paths near the auroral zone during the dark hours for one year were investigated. The average drift motion for the magnetic latitude 64 to 65°N showed a westward component of 115 m/sec; it was 58 m/sec for the region 65 to 67.5°. The observed speeds are best explained by internal gravity waves in the lower ionosphere. (auth) (UK)

35279 AMPLITUDE AND PHASE SCINTILLATIONS OF SPHERICAL WAVES. Chytil, Bohumil (Geophysical Inst., Prague). J. Atmos. Terrest. Phys.; 32: 961-6(May 1970).

The formulae for variances of amplitude and phase fluctuations of a wave after scattering from ionospheric irregularities are derived for the oblique incidence of a spherical wave. (auth) (UK)

35280 HEIGHT VARIATION OF F-REGION HORIZONTAL DRIFTS. Misra, R. K.; Rastogi, R. G. (Physical Research Lab., Ahmedabad, India). J. Atmos. Terrest. Phys.; 32: 967-9(May 1970).

The speed of horizontal drifts in the F region of the ionosphere over Thumba decreases with height; the gradient being larger during nighttime than during the daytime. (auth) (UK)

35281 PRODUCTION AND PREDICTION OF SPORADIC E. Whitehead, J. D. (Univ. of Queensland, Brisbane, Australia). Rev. Geophys. Space Phys.; 8: 65-144(Feb 1970).

A survey was made of the experimental observations and theories of formation of all types of sporadic E. The wind-shear theory is most likely to explain temperate-zone sporadic E. In the equatorial zone, vhf reflections are most probably due to the two-stream plasma instability, though gradient instabilities may play a part in producing the irregularities that cause hf vertical-incidence reflection. In the auroral zone, energetic particles dumped by any one of a variety of mechanisms cause ionization. This ionization has to be moved into thin layers of irregularities to cause auroral sporadic E and radio aurora reflections. Many recommendations are made to further the understanding of and the prediction of sporadic E for communication purposes. (auth)

35282 ROCKET MEASUREMENTS OF PLASMA DENSITIES AND TEMPERATURES IN VISUAL AURORA. McNamara, A. G. (National Research Council of Canada, Ottawa). Can. J. Phys.; 47: 1913-27(15 Sep 1969).

Direct measurements in active visual auroral forms using electrostatic plasma probes are described. On-board probes and an ejected Langmuir probe were used to provide maximum accuracy of measurement and freedom from perturbations. An electron density of 9.5×10^5 electrons/cm^3 was found within a visual band, with a background density of 1.5×10^5 electrons/cm^3 outside the band. The ionization maximum occurred at 107 km altitude, with a half-density vertical thickness of 7 km. The temperature of the thermal electrons over the interval 100 km to 168 km was found to range from 500°K to 1400°K. A hyperthermal electron component was also observed. A rocket-borne photometer determined the height of the optical emission region, and an array of optical, radio, and magnetic ground-based instruments were used to provide supporting geophysical data, and to define the position and variations of the auroral forms. (auth) (Canada)

35283 TRANSPORT AND ACCELERATION OF RADIATION-BELT PARTICLES. Faelthammar, C.-G. pp 5-29 of Calcul des Doses de Radiations dans l'Espace. Elbaz, C. (ed.). Toulouse; Comptes Rendus de Journees Europeennes (1968).

From Calculation of Radiation Doses in Space Conference, Toulouse, France. See CONF-680219.

There is now general agreement that the ultimate source of almost all the energetic particles in the radiation belts is the solar wind. The basis of this conclusion and the mechanisms by which solar-wind particles become radiation belt particles are explained. Two things are required: a small fraction of the solar wind particles must be brought deep into the magnetosphere, and these particles must be energized from their initial low energy to the high energies found in the radiation belts. Both of these results are achieved as a consequence of time-dependent electric and magnetic disturbance fields. The physical characteristics of the processes involved and the mathematical formalism used to analyze them are presented. (auth)

35284 LOSS PROCESSES AND EQUILIBRIUM DISTRIBUTION OF TRAPPED PARTICLES. Haerendel, G. (Max-Planck-Institut fuer Physik und Astrophysik, Garching, Ger.). pp 31-8 of Calcul des Doses de Radiations dans l'Espace. Elbaz, C. (ed.). Toulouse; Comptes Rendus de Journees Europeennes (1968).

From Calculation of Radiation Doses in Space Conference, Toulouse, France. See CONF-680219.

The relation between the trapped-particle population and the hydromagnetic-wave field interacting with the particles is discussed. The theory is illustrated by a sand-box model for the operation of the dominant process, the scattering of mirror points along lines of force. (M.O.W.)

35285 DESCRIPTION OF RADIATION BELTS (STABLE TRAPPING ZONES). Crifo, J.-F. (Service d'Aeronomie, Verrieres-le-Buisson, France). pp 49-84 of Calcul des Doses de Radiations dans l'Espace. Elbaz, C. (ed.). Toulouse; Comptes Rendus de Journees Europeennes (1968). (In French).

From Calculation of Radiation Doses in Space Conference, Toulouse, France. See CONF-680219.

An introductory survey of the stable trapping zone inside the earth's magnetosphere is presented. Some results obtained by applying the so-called "adiabatic approximation" to the motion of charged particles in the earth's magnetic field are discussed. In this way, one may trace out the boundary of the stable trapping zone, and define a coordinate system suitable for organizing the experimental data. A brief description is given of the stationary energetic proton and energetic electron belts, neglecting the time variation. Finally, some experimental data are presented that give a quick idea of the time variation of these particles. (auth)

35286 AURORAL PRECIPITATION AND SOLAR FLARES. Reme, H. (CESR, Toulouse). pp 85-116 of Calcul des Doses de Radiations dans l'Espace. Elbaz, C. (ed.). Toulouse; Comptes Rendus de Journees Europeennes (1968). (In French).

From Calculation of Radiation Doses in Space Conference, Toulouse, France. See CONF-680219.

There are two kinds of intense and sporadic phenomena in space radiation. Auroral phenomena caused by electron and proton precipitations whose main features are: light emissions, magnetic perturbations, and radio-wave absorption. Vlf emissions and x-ray precipitations are detected with launched balloon apparatus in well-delimited zones, which may move according to local time. Auroral particles, whose origin is still unknown, find their source most probably in the solar wind–magnetosphere interaction. During intense solar flares, there is an ejection of high-energy particles, mainly protons and alpha particles, whose fluxes are often considerable and a plasma cloud which transports about 10^{32} ergs. After diffusion in space, these particles give intense geomagnetic effects at high altitudes. (auth)

35287 CALCULATION OF B. L. COORDINATES BY PERTURBATION METHOD. Laval, G.; Pellat, R. (CENFAR, Paris. CERTS, Toulouse). pp 129-37 of Calcul des Doses de Radiations dans l'Espace. Elbaz, C. (ed.). Toulouse; Comptes Rendus de Journees Europeennes (1968). (In French).

From Calculation of Radiation Doses in Space Conference, Toulouse, France. See CONF-680219.

McIlwain proposed a method for computing B, L coordinates, using a spherical harmonic expansion of the geomagnetic field. His method provides a great accuracy, but involves a computing-time that may become prohibitive. Dose computations allow, in most cases, an error of a few percent on the values of L. It is then possible to replace the direct computation by a perturbation method, in which the perfect dipole is the zero-order approximation. Computations are presented by this method for the B, L coordinates, and the value of L is determined with the help of the exact McIlwain formula. (auth)

35288 PROGRAM OF DOSE CALCULATION. Brettes, J.; Philippon, J.-P. (CERTS, Toulouse). pp 139-64 of Calcul des Doses de Radiations dans l'Espace. Elbaz, C. (ed.). Toulouse; Comptes Rendus de Journees Europeennes (1968). (In French).

From Calculation of Radiation Doses in Space Conference, Toulouse, France. See CONF-680219.

Electron and proton doses impinging a satellite over one or many orbits are calculated. This computation is made in three steps—orbit computation, transformation of geographical coordinates into B, L coordinates, and dose computation. Two methods are detailed for the transformation of the coordinates: the classical one (McIlwain method) and the perturbation one which is sufficiently accurate in almost all cases and saves much computation time. (auth)

35289 A METHOD FOR ESTIMATING PARTICLE FLUXES AFFECTING A SATELLITE IN SPACE. Quaranta, G. (CGE-FIAR, Milan). pp 165-71 of Calcul des Doses de Radiations dans l'Espace. Elbaz, C. (ed.). Toulouse; Comptes Rendus de Journees Europeennes (1968).

From Calculation of Radiation Doses in Space Conference, Toulouse, France. See CONF-680219.

The method for computing electron and proton fluxes impinging on a spacecraft is described. The computer program is summarized. The computation is performed for Van Allen belts and solar flares, simply introducing orbital parameters. A special subroutine converts integral fluxes of radiation doses in rads, 1-MeV electron equivalent flux, and fast neutron equivalent flux. (auth)

35290 PRELIMINARY STUDY OF THE D-2 EXPERIMENT. Hurlet, J.; Crifo, J.; Coufleau, P. (CNRS, Verrieres-le-Buisson, France). pp 243-60 of Calcul des Doses de Radiations dans l'Espace. Elbaz, C. (ed.). Toulouse; Comptes Rendus de Journees Europeennes (1968). (In French).

From Calculation of Radiation Doses in Space Conference, Toulouse, France. See CONF-680219.

The dose received by a satellite D-2 during its mission, is determined from a model of distribution of electrons and protons. Starting from this prediction some examples of aging of different materials and subsystems are presented. (auth)

35291 CONJUGATE RIOMETER STUDIES OF AURORAL ZONE COSMIC-NOISE ABSORPTION. Hajkowicz, L. A. (Dept. of Supply, Melbourne). Aust. J. Phys.; 23: 187-96(Apr 1970).

Associated auroral (SAI) and bay-type (SVA) absorption events were compared for Macquarie Island and the northern conjugate area, using 30-MHz riometer records for 1966. Consistent time lags between associated absorption features were found for Macquarie Island–Kotzebue–College. An apparent east–west motion of absorption regions, derived from this time lag, indicated that the conjugate point to Macquarie Island, during moderately disturbed periods ($K_p = 3+$), is on average 170 ± 60 km west of Kotzebue. The yearly analysis of conjugate (Macquarie Island–Kotzebue) cosmic-noise absorptions indicated a large absorption decrease during the southern winter and an absorption increase during the equinoctial periods. The diurnal distributions of absorption show a minimum around the evening transition period and several maxima during the night and morning hours. Conjugacy breakdown, on average, occurs most frequently in the periods close to the evening and morning (solar illumination) transitions at one conjugate station. The majority of uncorrelated absorption peaks are observed at Macquarie Island; this is suggested to be due to the differences in the shapes of the auroral ovals in the southern and northern hemispheres. (Australia)

35292 DYNAMICS OF THE INTERACTION OF THE SOLAR WIND WITH A PLANETARY ATMOSPHERE. Cloutier, Paul A. (Rice Univ., Houston, Tex.). Radio Sci.; 5: 387-9(Feb 1970).

From Symposium on Planetary Atmospheres and Surfaces, Woods Hole, Mass. See CONF-690835.

Dynamics of the interaction of a magnetized supersonic plasma flow (solar wind) with a planetary ionosphere are examined. The flow behavior across a bow magnetohydrodynamic shock and in the post-shock region, where the flow interacts with the planetary ionosphere, is analyzed. It is argued that the pressure balance between the solar wind and the post-shock plasma is provided mainly by static gas pressure rather than by a large magnetic field "build-up." (auth)

35293 ARTIFICIAL CONJUGATE AURORAL AND AFTERGLOW SPECTRA. Markham, Thomas P. (Air Force Cambridge Research Labs., Bedford, Mass.). Planet. Space Sci.; 18: 731-40(May 1970).

Spectrograms of the artificial aurora generated by Starfish in the northern conjugate region are analyzed. The first spectrogram obtained in the first five seconds is compared with one obtained by Tinsley (1966) from Western Samoa during the first eleven seconds. (auth) (UK)

35294 STUDY OF SEASONAL CHANGES IN THE LOWER THERMOSPHERE AND THEIR IMPLICATIONS. Waldteufel, P. (CNET-RSR, Issy-les-Moulineaux, France). Planet. Space Sci.; 18: 741-8(May 1970).

Incoherent scatter observations of the atmospheric density and temperature in the lower thermosphere are reported. A seasonal variation appears, both in the density at 100 km height and in the temperature profile between 100 and 120 km. The main implication of these variations is a seasonal change in neutral composition, with a maximum of the $(O)/(N_2)$ ratio in winter. This phenomenon, together with F-region observations, strongly supports the explanation of the ionospheric winter anomaly in terms of seasonal changes in neutral atmosphere composition. (auth) (UK)

35295 ELECTROSTATIC FIELD AT THE MAGNETOPAUSE. Willis, D. M. (Radio and Space Research Station, Slough, Eng.). Planet. Space Sci.; 18: 749-69(May 1970).

The discharge through the magnetosphere–ionosphere circuit of the electrostatic field at the magnetopause is examined quantitatively using an idealized circuit analogue. The two geomagnetic flux tubes linking the magnetopause to the ionosphere are treated as uniform transmission lines and the magnetopause and ionosphere are regarded as terminal impedances. It is argued that the electrostatic field is neutralized predominantly by the polarization of the ambient magnetospheric plasma at the magnetopause. The characteristic time constant for the discharge of the residual electrostatic field through the magnetosphere–ionosphere circuit is of the order of a few hours. Therefore the residual field seems unlikely to be completely discharged unless the solar-wind remains steady for about a day. Nevertheless, the tendency for the residual field to be discharged through the magnetosphere–ionosphere circuit generates hydromagnetic "twist" (TEM) waves which travel along the geomagnetic lines of force to the polar ionosphere. These waves generate Hall currents in the ionosphere, which contribute to the magnetic agitation observed at high latitudes. (auth) (UK)

35296 INFLUENCE OF METASTABLE HELIUM ON THE LABORATORY EXCITATION OF $O(^1D)$. McConkey, J. W.; Pettifer, R. E. W.; Moran, K. A. (Queen's Univ., Belfast). Planet. Space Sci.; 18: 771-6(May 1970).

The excitation of the ^1D state of atomic oxygen was studied in an oxygen–helium discharge which is a strong source of the forbidden oxygen lines. Collisional deactivation by oxygen molecules is the predominant de-excitation mechanism of the $O(^1D)$ atoms and the predominant excitation mechanism is shown to be via the collision of metastable helium atoms and ground state oxygen molecules. A rate coefficient of 10^{-12} cm^3 sec^{-1} was obtained for this reaction. (auth) (UK)

35297 ABOUT THE POSSIBILITY OF VLF CHERENKOV EMISSION IN THE IONOSPHERE BY ARTIFICIAL ELECTRON BEAMS. Etcheto, J.; Gendrin, R. (Groupe de Recherches Ionospheriques, St-Maur, France). Planet. Space Sci.; 18: 777-83(May 1970).

The suggestion that the Cherenkov mechanism was a possible source of vlf hiss was put forward shortly after the discovery of these emissions (Ellis 1957). The present note (1) demonstrates, on the basis of energetic considerations, that the mechanism by which Bell (1968) intended theoretically to obtain measurable vlf electromagnetic fluxes from Cherenkov effect produced by artificial electron beam, must be ruled out; (2) shows that, if a specific relation between the beam velocity and the proton Alfvén velocity is fulfilled, it is possible to obtain sufficient electromagnetic fluxes inside a very narrow angle of ray paths, without assuming any "bunching" effect. Such a peculiar emission is only marginally detectable. The authors also point out that these theoretical results have been recently confirmed by the experiments of others (Hess 1969; Mead et al. 1969). (UK)

35298 EFFECT OF A LARGE RING CURRENT ON TOPOLOGY OF THE MAGNETOSPHERE. Sozou, C.; Windle, D. W. (Univ. of Sheffield, Eng.). Planet. Space Sci.; 18: 699-707(May 1970).

The topology of the magnetosphere in the presence of a large, time-independent ring current, which is symmetric with respect to the axis of the Earth's dipole field and, in a certain region of the equatorial plane, reverses the direction of the dipole field, is investigated. Two model ring currents are considered. In one case the ring current is centered at 3 and in the other at 7 Earth radii from the center of the Earth. It is shown that when the intensity of the ring current is large enough, the total field has two neutral points in the equatorial line of a meridional cross section; the neutral points comprise an X-type point and an O-type point with the X-type point nearer the Earth. (auth) (UK)

35299 POLARIZATION OF AURORAL ECHOES. Harang, L.; Troeim, J. (Norwegian Defence Research Establishment, Kjeller). Planet. Space Sci.; 18: 655-60(May 1970).

Tests of polarization of auroral echoes at 40 Mc were made. Horizontal and vertical Yagis tilted 10° above the horizontal plane were used for alternative reception, an identical Yagi with the elements at 45° from vertical was used for continuous transmission. The V- and H-amplitudes of the echoes were measured and it turned out that the ratio V/H varied strongly within the range interval 200 to 800 km. It could be shown that this is due to the different aerial patterns of the horizontal and vertical Yagis. When the different characters of the aerial patterns were taken into account the observed range dependence of the V/H-amplitudes of the echoes could be explained. There seems thus to be no difference in the scattered amplitudes when the radio pulses are exciting the auroral electron blobs in the scattering process along or perpendicular to the geomagnetic field lines on the frequency of 40 MHz, the waves are being depolarized during the scattering process. (auth) (UK)

35300 EXCITATION AND RADIATIVE TRANSPORT OF O I 1304 A RESONANCE RADIATION. I. THE DAYGLOW. Strickland, D. J.; Donahue, T. M. (Univ. of Pittsburgh). Planet. Space Sci.; 18: 661-89(May 1970).

Radiative transfer theory is developed for the 1304 Å triplet of atomic oxygen which includes the effects of pure absorption by molecular oxygen and variability of the temperature governing the relative populations of the ground state ^3P_j levels. Starting from an essentially complete intensity–height profile for the dayglow, the theory is used to determine the initial source function or the production rate. From the solution, the authors discuss quantitatively the important dayglow excitation sources. The solutions are shown to be somewhat sensitive to the following parameters: (1) the oscillator strength f, (2) the temperature governing the Doppler line width, (3) the temperature governing the ^3P_j levels, and (4) O_2 absorption below absorption below about 130 km. The assumption of complete frequency redistribution is applied and the basis of its validity is analyzed with regard to the given problem. A source is required in the F1 region whose strength is about 200 excitations per cm^3 per sec at 170 km. The altitude profile for the required source agrees well with those calculated for excitation of oxygen by suprathermal photoelectrons. (auth) (UK)

35301 EXCITATION AND RADIATIVE TRANSPORT OF O I 1304 A RESONANCE RADIATION. II. THE AURORA. Donahue, T. M.; Strickland, D. J. (Univ. of Pittsburgh). Planet. Space Sci.; 18: 691-7(May 1970).

Radiative transfer calculations appropriate to optically thick media in the presence of molecular absorption were performed that derive the rate of excitation of the O(3^3S) term in an aurora from observed intensity profiles. Comparison of the O(3^3S) profile with N_2^+ 3914 Å, OI 1356 Å, and N_2 L–B–H excitation profiles obtained in the same aurora shows that the N_2^+ excitation occurs more efficiently than the others at the lower border of the aurora as well as at high altitudes. The excitation of the ^{1}S level of oxygen appears in turn to be confined to a very narrow region in the middle of the auroral layer. As in other auroras investigated with sounding rockets these results appear to require a local source of electron acceleration in the lower regions of the auroral glow. (auth) (UK)

35302 STUDY OF THE DIURNAL VARIATIONS OF THE 5577 A [O I] AIRGLOW EMISSION AT SELECTED IGY STATIONS. Brenton, June G. (Geo-Science Inc., Alamagordo, N. Mex.); Silverman, S. M. Planet. Space Sci.; 18: 641-53(May 1970).

The diurnal variation of the 5577 Å [OI] airglow emission was studied by the normalization method of Silverman (1964) using data, primarily from the IGY Annals, from 22 stations. Statistically significant variations were not found at the highest latitudes. At midlatitudes the diurnal variation exhibits a maximum during the night, while in a large belt including the equatorial latitudes there is a pronounced minimum sometime during the night. Definite seasonal effects were found for the 13 stations for which sufficient data were available. The Sacramento Peak, New Mexico data showed definite changes that occurred on a monthly basis. The IGY–IGC data were compared with those for 1962 for Sacramento Peak. No sunspot-cycle effect was found. The data are discussed in terms of the Chapman mechanism. (auth) (UK)

35303 BALLOON-BORNE OBSERVATION OF THE INTENSITY VARIATION OF THE OH EMISSION IN THE EVENING TWILIGHT. Moreels, G. (CNRS, Verrieres-le-Buisson, France); Evans, W. F. J.; Blamont, J. E.; Jones, A Vallance. Planet. Space Sci.; 18: 637-40(Apr 1970).

In order to obtain good experimental data on the twilight and daytime variations of the OH intensity and rotational temperature, a balloon-borne photometer was designed. The instrument has three narrow band (100A) interference filters designed to sample the airglow spectrum in the region of the (8–6) OH band at 2.0 μ. The time variation of the Q branch of the (8–6) band of OH was observed in the late afternoon dayglow and early evening twilight. This variation consists of a dip followed by a rapid recovery. It is likely attributable to enhancement in the ozone concentrations above 60 km at twilight. (UK)

35304 MODIFIED WKB METHOD FOR COUPLED IONOSPHERIC EQUATIONS. Ludwig, Donald (New York Univ., N. Y.). Contract NONR-285(48). J. Atmos. Terrest. Phys.; 32: 991-8(Jun 1970).

The WKB method has been successfully applied to the coupled ionospheric equations, but this method breaks down where there is strong coupling between any two of the four characteristic waves. Here it is shown how this method can be modified to produce a uniformly valid approximation in the presence of strong coupling of the waves. The uniform approximation involves the Airy function and its derivative, and it reduces to the WKB approximation outside of the coupling region. The variables and coefficients in the uniform expansion are expressed in terms of those for the WKB expansion. (auth) (UK)

35305 FAST TIME-RESOLVED SPECTRA OF ELECTROSTATIC TURBULENCE IN THE EARTH'S BOW SHOCK. Fredricks, R. W.; Coroniti, F. V.; Kennel, C. F.; Scarf, F. L. (TRW Systems Group, Redondo Beach, Calif.). Phys. Rev. Lett.; 24: 994-8(4 May 1970).

Time-resolved spectra of electrostatic turbulence in the Earth's bow-shock structure are presented. Spectral details on scales for a few Debye lengths indicate that single modes or groups of single modes dominate the turbulent spectrum. These modes are probably ion–acoustic or Buneman instabilities of short wavelength ($k\lambda_D \sim 1$) which are generated in parts of the shock microstructure containing diamagnetic drift currents. (auth)

35306 SPECTRUM ANALYSIS OF IONOSPHERIC RADAR RETURNS. Roberts, J. B. G. (Royal Radar Establishment, Malvern, Eng.). Electron. Lett.; 6: 196-7(2 Apr 1970).

A digital method of extracting ionospheric information from the Doppler broadening of radar signals is presented. One-bit correlation, used by Weinreb (1966) in radioastronomy, is applied to measuring autocorrelation functions of ionospheric incoherent scatter returns. Calculated correlation functions are fitted to the observations to derive electron and ion temperatures. (auth) (UK)

35307 DEVELOPMENT OF IONIZATION PROCESSES IN NIGHT IONOSPHERE WITH GEOMAGNETIC STORMS. Nestorov, G. (Inst. of Geophysics, Sofia). Compt. Rend. Acad. Bulg. Sci.; 23: 149-52(1970).

Data were obtained by measuring nocturnal ionospheric absorption at a frequency of 593 kHz. The equivalent frequency of signal $f_i = f\cos i = 480$ kHz, where i is the angle of incidence of the wave on the ionosphere. Under these conditions the reflection takes place at a height of about 120 km, while the absorbing region is located within the limits 95 to 120 km. The data are discussed. (M.O.W.)

35308 CALCULATION OF IONOSPHERIC PROFILES FROM DATA GIVEN ON OBLIQUE INCIDENCE IONOGRAMS. Smith, M. S. (Government Communications Headquarters, Cheltenham, Eng.). J. Atmos. Terrest. Phys.; 32: 1047-56(Jun 1970).

A method is described for calculating the electron-density distribution in the ionosphere, between two locations, from the information contained in an oblique incidence ionogram. The technique derives an ionospheric profile which yields an oblique ionogram from ray-tracing identical with that obtained by actual measure-

ment. The profile is split into segments, with a particular form of equation representing the variation of electron density with height in each segment. The segment constants are calculated to give the correct ground range and virtual path length for points taken at intervals along the ionogram trace. The technique is readily applicable to monotonic profiles; an approximation is used to deal with re-entrant profiles. (auth) (UK)

35309 LUNAR TIDAL VARIATIONS IN THE EQUATORIAL SPORADIC-E LAYER. Joshi, B. K.; Kotadia, K. M. (Gujarat Univ., Ahmedabad, India). J. Atmos. Terrest. Phys.; 32: 1057-66(Jun 1970).

Moon values of f_0E_s and f_bE_s at Kodaikanal were studied to find lunar tidal variations in the equatorial sporadic-E layer (E_{eq} type). It is shown that the phases of lunar diurnal and semidiurnal variations in f_0E_s and f_bE_s are in agreement with those of the H component of the Earth's magnetic field, the agreement with f_bE_s being more clear. The amplitude of lunar variation in f_0E_s at Kodaikanal is smaller than that found at Ibadan and Huancayo. The variation in f_0E_s is predominantly semidiurnal in a high-sunspot period, while the diurnal component, though almost equal in high as well as low solar activity, dominates over the semidiurnal one in low sunspot period. The phase of lunar semidiurnal variation of f_0E_s practically remains same in both the sunspot epochs, but that of the diurnal variation changes by 4 to 9 hr. The close agreement between the lunar variations of f_bE_s (and f_0E_s) and horizontal component of the Earth's magnetic field at the equator suggests that the strengthening or weakening of E_s ionization is controlled by the same physical process as is responsible for the increase or decrease in the Earth's magnetic field at the equator. (auth) (UK)

35310 SEASONAL ANOMALY IN THE ELECTRON DENSITY OF THE TOPSIDE F2 REGION. Fatkullin, M. N. J. Atmos. Terrest. Phys.; 32: 1067-75(Jun 1970).

Data obtained by means of the ionospheric topside sounder satellite Alouette-1 show that in the daytime the seasonal anomaly in the electron concentration extends to heights above h_mF2 in a manner that depends on the latitude. In the northern hemisphere over the American continent the anomaly extends to heights near 500 km at geographic latitudes between 46 and 53°N. The seasonal anomaly in the F2 layer appears to be mainly due to anomalous behavior in summer. The results obtained refer to a period near sunspot minimum. (auth) (UK)

35311 EXPERIMENTAL AND THEORETICAL OBSERVATIONS ON THE TRANSIENT EXCITATION OF SCHUMANN RESONANCES. Jones, D. Llanwyn; Kemp, David T. (London Univ.). J. Atmos. Terrest. Phys.; 32: 1095-1108(Jun 1970).

An experimental and theoretical investigation into the excitation of the resonances of the Earth–ionosphere cavity (Schumann resonances) by individual atmospherics of unusually large amplitude at elf is presented. In the experimental work both the vertical electric and the horizontal magnetic vectors of the electromagnetic field were analysed. The theoretical study employed a propagation model derived from an earlier analysis of experimental Schumann resonance and atmospherics data. A close correspondence between experiment and theory is demonstrated. The technique employed in analysing the data enables the location of the source to be determined from single station observations. (auth) (UK)

35312 F REGION DURING AN ECLIPSE: A THEORETICAL STUDY. Stubbe, Peter (Max-Planck-Institut fuer Aeronomie, Lindau, Ger.). J. Atmos. Terrest. Phys.; 32: 1109-16(Jun 1970).

Theoretical solutions are presented for the electron and ion densities, neutral, electron, and ion temperatures, and plasma velocities in the height range from 120 to 1500 km for a total eclipse. The computations were carried out for the coming eclipse at Wallops Island on March 7, 1970. (auth) (UK)

35313 MOTION OF ION CLOUDS IN THE IONOSPHERE: SPHERICAL CLOUD IN UNIFORM ANISOTROPIC PLASMA. Kato, Susumu; Sakurai, Hideji (Kyoto Univ.). J. Atmos. Terrest. Phys.; 32: 1117-30(Jun 1970).

Movement of a spherical ionized cloud in the ionosphere is discussed with application to artificial ion clouds released from rockets. The set-up electrical polarization field is analytically calculated for the irregularity with conductivity which is λ times that of the uniform ambient plasma, where λ is a constant. This field is found to be very small for a small λ, as in the case of B_a^+ clouds released from rockets. This small polarization results from a large dissipation current, which flows outside the irregularity and is driven by the polarization field transferred without decrease over large distance along the lines of force of geomagnetic field. It is suggested that the irregularity moves with the ambient plasma for $\lambda < 10$ above 150-km height. Due to a nonuniformity of the irregularity velocity on the surface, the irregularity deforms in time which is only a few minutes at 150 km height and longer with increasing height. The authors try to find what the real nonuniform ionosphere requires to modify the present result. It is expected that the result in the present work is applicable to an artificial ion cloud in a good shape during an initial period during which the cloud is gradually expanding. (auth) (UK)

35314 ELECTRON DENSITIES MEASURED BY THE PARTIAL REFLECTION METHOD COMPARED WITH SIMULTANEOUS ROCKET MEASUREMENTS. Haug, A. (Auroral Observatory, Tromsoe, Norway); Jespersen, M.; Kane, J. A.; Thrane, E. V. J. Atmos. Terrest. Phys.; 32: 1139-42(Jun 1970).

Electron densities measured by the partial reflection method and by rocket techniques during the solar eclipse of May 20, 1966, are in satisfactory agreement below about 82 km height. A discrepancy above 82 km is almost certainly due to a systematic error in the partial reflection experiment caused by an increasing importance of oblique echoes at high altitudes. (auth) (UK)

35315 COOLING OF IONOSPHERIC ELECTRONS BY INELASTIC COLLISIONS WITH $O(^3P)$. Whitten, R. C. (Ames Research Center, Moffett Field, Calif.). J. Atmos. Terrest. Phys.; 32: 1143-5(Jun 1970).

The heating of the F2 layer caused by photoelectrons of nonlocal origin is reconsidered. It is shown that inelastic collisions between electrons and $O(^3P)$ prevent large increases of electron temperature. (auth) (UK)

35316 AURORAL ENHANCEMENT OF IONOSPHERIC ELECTRON DENSITY. Bates, Howard F. (Stanford Research Inst., Menlo Park, Calif.). J. Atmos. Terrest. Phys.; 32: 1153-7(Jun 1970).

A localized increase in ion density of the F layer and topside ionosphere at 75 to 80° magnetic latitude around magnetic noon has been termed the polar peak. Results reported previously suggest that this polar peak is produced by the same flux that is responsible for the dayside aurora. The observed behavior of the polar peak corresponds to that expected from the auroral precipitation alone, and no separate source of precipitating soft particles appears to be needed to explain the effect. (auth) (UK)

35317 DAILY VARIABILITY OF THE EQUATORIAL ELECTROJET CURRENT SYSTEM. Gupta, Jagdish C. (National Physical Lab., New Delhi). J. Atmos. Terrest. Phys.; 32: 1159-64(Jun 1970).

The observed daily variability in the amplitude and in the type of the equatorial electrojet current system was studied. The possible source of these day-to-day variations seems to be the irregularities, even on geomagnetic quiet days, in the influx of the solar extreme ultraviolet radiation (xuv). A further analysis shows that the intensity of the equatorial electrojet during the month of the peak activity in the IGY period was about 9 times higher than the most quiet month of the previous minimum activity period of 1953–55. (auth) (UK)

35318 DRIFT AND ANISOTROPY PARAMETERS OF THE IRREGULARITIES IN THE E AND F REGIONS OF IONOSPHERE OVER THUMBA DURING 1964. Rastogi, R. G.; Chandra, H.; Deshpande, M. R. (Physical Research Lab., Ahmedabad, India). J. Atmos. Terrest. Phys.; 32: 999-1006(Jun 1970).

Fading records of the E- and F-region reflections at Thumba for the daytime hours in the year 1964 were analyzed by full correlation method applying the anisotropy corrections. The random component of the drift was found to be 0.95 and 0.70 times the steady component in the E and F regions respectively thereby reducing the true drift speed to 74 m/sec in the E region and 98 m/sec in the F region. The true drift direction is found to be towards magnetic west (267°E to geog. N) for each of the regions. The characteristic ellipse defining the diffraction pattern is elongated along magnetic N–S, the minor axis being about 100 m and the axial ratio about 3. (auth) (UK)

35319 ENERGY DEPOSITION BY AURORAL ELECTRONS IN THE ATMOSPHERE. Berger, Martin J. (National Bureau of Standards, Washington, D. C.); Seltzer, Stephen M.; Maeda, Kaichi. Contract R-80. J. Atmos. Terrest. Phys.; 32: 1015-45(Jun 1970).

The spatial distribution of the energy deposited by electrons in the atmosphere was calculated by the Monte Carlo method. The distribution was obtained as a function of the altitude and of the radial distance from the axis of the incident electron beam. The calculations took into account the deflection of the electrons by the geomagnetic field, and the scattering and slowing down due to multiple Coulomb interactions with atomic nuclei and orbital electrons. The assumed conditions were: (1) a semi-infinite air

medium, extending downwards from a height of 300 km, with a composition and density corresponding to that of the CIRA (1965) mean atmosphere; (2) a vertical magnetic field with a strength of 0.6 g; (3) monoenergetic incident electron beams that are symmetric about a chosen field line; (4) incident electron energies between 20 and 2 keV; (5) various incident pitch-angles between 0° and 90°, or a pitch-angle distribution corresponding to an incident flux isotropic over the downward hemisphere. Calculations made with the same program, for a constant-density medium and no magnetic field, gave good agreement with the results of laboratory experiments. The calculations were also in agreement with recent observations on an artificial aurora produced in the atmosphere with 8.7-keV electrons. (auth) (UK)

35320 RESULTS OF SPECIAL OBSERVATIONS FOR THE PROTON FLARE PROJECT, 1969. 5. POLAR CAP DISTURBANCE OF JUNE 7, 1969, OBSERVED ON THE PHASE OF VLF WAVES. Nakajima, Toshio; Ishii, Takahiroo; Tsuchiya, Kiyomi; Sakurazawa, Akira; Hakura, Yukio (Radio Research Lab., Tokyo). J. Radio Res. Lab., Tokyo; 17: 49-54(Jan 1970).

Phase measurement of transpolar vlf waves is a very sensitive method of detecting "solar proton events" at middle latitudes. The polar cap disturbance caused by a small proton enhancement on June 7–11, 1969, on the phase of NAA 17.8-kHz, ALDRA 12.3-kHz, and GBR 16.0-kHz signals was detected, and the high sensitivity of the method of vlf phase measurement was confirmed. (auth) (NSA of Japan)

35321 ELECTROSTATIC FIELD IN THE TRAIL OF IONOSPHERIC SATELLITES. Vaglio-Laurin, R.; Miller, G. (New York Univ., Bronx). AIAA (Amer. Inst. Aeronaut. Astronaut.) J.; 8: 1098-1103(Jun 1970).

Conceptual similarities between the electrostatic near wake of an ionospheric satellite and the fluid-dynamic near wake of a blunt-base body in low-speed flow are noted. A simplified model of the electrostatic wake is constructed accordingly. There are recognized distinct regions where different approximate solutions of the Poisson equation are valid, namely: 1) an outer region, conceptually analogous to the external inviscid flow, where the self-induced electric field due to the charge separation develops independently of the boundary conditions on the body; 2) an inner region, analogous to the recirculation zone, where the electric field configuration is largely governed by the vehicle shape, whereas the field intensity is controlled by the flight condition (the ion Mach number) and by the difference between the body floating potential and the minimum potential characteristic of the flow; 3) an intermediate region, analogous to the fluid-dynamic free shear layer, where a rapid adjustment between the two aforenoted solutions is attained. Analyses appropriate to the various regions are presented, and their combination to obtain a composite solution is described. The merit of the model resides in its ability to provide rapid estimates of the electrostatic wake; its validity is corroborated by heuristic arguments as well as by comparisons with the results of numerical solutions for axisymmetric configurations. (auth)

35322 A LABORATORY STUDY OF THE WAKES OF IONOSPHERIC SATELLITES. Hester, S. D.; Sonin, Ain A. (Massachusetts Inst. of Tech. Cambridge). Contract NONR-1841 (93). AIAA (Amer. Inst. Aeronaut. Astronaut.) J.; 8: 1090-8(Jun 1970).

A steady-state plasma wind tunnel is described in which most of the similarity parameters governing the flow around ionospheric satellites can be reproduced. A study is presented of the wakes of bodies (mostly spheres) with dimensions ranging from comparable with the Debye length to large compared with the Debye length. No magnetic field was applied in these experiments. The measurements of near wakes agree in essence with available theory and/or previous experiment. The far wakes of spheres were found to have a wave-like character largely independent of body potential. (auth)

Low-Temperature Physics

Refer also to abstracts 35573 and 35690.

35323 (RHEL/R-193) HEAT TRANSFER AND PRESSURE DROP FOR FORCED FLOW OF PRESSURIZED LIQUID HELIUM AND TWO-PHASE HELIUM IN TUBES. Colyer, B. (Rutherford High Energy Lab., Chilton (England)). Mar 1970. 31p. Dep. CFSTI (U. S. Sales Only). UK 5s, 0d.

Equations are derived for heat transfer and pressure drop for forced flow of single-phase and two-phase helium in tubes. For a given tube, under certain conditions, it is shown that there exist maximum and optimum mass flowrates. Tables of certain functions required for calculation are given. (auth) (UK)

35324 WAVE PROCESSES IN He II NEAR THE SURFACE OF A HEATER. Gulyaev, A. I. (Inst. of Physics Problems, Moscow). JETP Lett. (USSR)(Engl. Transl.); 11: 221-4(5 Apr 1970).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 11: 332-7 (5 Apr 1970).

Mobile "sources" of radiation of (first) sound, which are not produced in He I, were observed near a heated surface in He II by Schlieren photography of the optical inhomogeneities excited in the liquid He following a pulsed release of Joule heat from a thin flat heater. The propagation of these sources along the heater is also accompanied by excitation of second sound. (auth)

35325 TRANSITION TEMPERATURE AND TUNNELING CHARACTERISTICS OF FERRIMAGNETIC INSULATOR–SUPERCONDUCTOR SANDWICHES. Hauser, J. J. (Bell Telephone Labs., Murray Hill, N. J.). Phys. Rev., B; 1: 3624-8(1 May 1970).

The depression of the transition temperature of In films (thinner than the effective coherence length ξ_{eff}) on a single ferrite film grown in a parallel magnetic field is inversely proportional to the In film thickness. This result agrees with that already reported for an indium film sandwiched between two ferrites magnetized in parallel field; the transition temperature for the single-ferrite case can be obtained from the double-ferrite case by multiplying the ratio ξ_{eff}/d by 2 (which, except for a small mean-free-path correction, means dividing the indium film thickness d by 2). The same results are obtained if indium is replaced by tin. Tunneling junctions ($AlAl_2O_4InFe_3O_4$) were investigated as a function of temperature and In film thickness. The In films were found to display gapless or quasigapless superconductivity. For a fixed reduced transition temperature, the degree of gapless superconductivity is the same as that obtained by the proximity effect of a conducting ferromagnet. (auth)

35326 SUPERCONDUCTING TRANSITION OF GALLIUM IN POROUS GLASS AROUND 2°K. Bogomolov, V. N.; Krivosheev, V. K.; Malkovich, R. Sh.; Chudnovskii, F. A. (Inst. of Semiconductors, Leningrad). Sov. Phys.-Solid State (Engl. Transl.); 11: 3064-5(Jun 1970).

Translated from Fiz. Tverd. Tela; 11: 3648-9(Dec 1969).

Superconducting transitions were detected at 1.7 to 2.7°K in porous glasses with the pores (70 to 250 Å) filled with gallium. A mutual inductance technique was used to detect superconductivity. T_c tends to decrease with etching treatment, which increases the pore diameter, thereby indicating a size effect. (D.L.C.)

35327 LONGITUDINAL FLUCTUATIONS OF THE ORDER PARAMETER IN He II NEAR T_λ. Szepfalusy, P. (Institut Max von Laue-Paul Langevin, Garching, Ger.). Phys. Lett.; 32A: 127-8(15 Jun 1970).

The contributions of density and entropy fluctuations to the longitudinal fluctuations of the order parameter are investigated in superfluid helium near the lambda point. (auth)

35328 RADIATION EMITTED FROM A SUPERCONDUCTING TUNNEL JUNCTION. Lee, Patrick A.; Scully, Marlan O. (Massachusetts Inst. of Tech., Cambridge). Ann. N. Y. Acad. Sci.; 68: 387-99(Feb 1970).

The BCS theory is reviewed briefly, the ac and dc Josephson effects are discussed, and the results of a more detailed theory of the radiation emitted from a superconducting tunnel junction are outlined. (M.H.R.)

35329 BEHAVIOUR OF A SELF-INTERACTING, MULTIPLY CONNECTED SUPERCONDUCTING CIRCUIT. Sikora, P. T. (Atomic Energy Research Establishment, Harwell, Eng.); Carroll, K. J.; Sisemore, L. K.; Nicholson, J. E. Cryogenics; 10: 233-5 (Jun 1970).

An external current is applied to a superconducting network in which a magnetic field of one of the branches modulates the critical current of a second branch. The assumptions of loss-less flow (when possible) and flux conservation predict uniquely the behavior of the system. (auth) (UK)

35330 AC LOSSES IN COMPOSITE SUPERCONDUCTING WIRES. Salmon, D. R.; Catterall, J. A. (National Physical Lab., Teddington, Eng.). J. Phys., D (London); 3: 1023-32(Jul 1970).

Measurements have been made at 4.2 K of the losses in filamentary composites of niobium in copper carrying transport currents of up to 70 A at frequencies in the range 50 to 800 Hz. Critical currents and B–H loops were also measured. The experimental results can be accounted for on the basis of a physical model in which the composite wire behaves as a solid superconductor. The effect on the losses due to twisting the composite wires has also been investigated. (auth) (UK)

35331 STUDY OF THE EFFECT OF A DILUTE MAGNETIC ALLOY ADJOINING A SUPERCONDUCTOR BY THE TUNNEL EFFECT ON THE SUPERCONDUCTOR SIDE. Dumoulin, L.; Gyyon, E.; Nedellec, P. (Faculte des Sciences, Orsay, France). Solid State Commun.; 8: 885-8(Jun 1970). (In French).

Some comparative results obtained from electron tunneling on the superconducting side of couples of sandwiches of Pb/Cu and Pb/CuFe (300 ppm) are presented. The dilute magnetic impurities cause an additional decrease of T_c. Close to their critical temperature the gapless behavior of the two types of sandwiches is similar. However at low temperature a stronger gapless behavior is found for CuFe. The results are compared with ones on homogeneous superconducting dilute magnetic alloys. (auth) (UK)

35332 CLASSICAL SCATTERING OF A SPHERE BY A VORTEX: POSSIBLE EXPLANATION OF THE STEYERT-TAYLOR-KITCHENS EXPERIMENT. Titus, William J. (Univ. of Minnesota, Minneapolis). Contract AT(11-1)-1569. J. Low Temp. Phys.; 2: 291-308(Apr-May 1970).

A classical model for the scattering of a small particle by a rectilinear vortex in liquid He II is studied for the purpose of explaining the experimental results of Steyert, Taylor, and Kitchens. Although many of their observations are accounted for, verification of the theory would require a re-analysis of the experimental data. A classical analog of an Iordanskii force is also discussed. (auth)

35333 BOSE FLUID IN RESTRICTED GEOMETRY: HIGH-ENERGY NEUTRON SCATTERING. Reatto, L. (Univ., Milan). J. Low Temp. Phys.; 2: 353-70(Apr-May 1970).

The existence of a low-temperature phase with "infinite susceptibility" in a Bose fluid in two dimensions and in thin films is discussed. In particular, the high-temperature approach to the relative phase transition is considered by a second-order theory based on the use of finite-temperature Green functions. It is shown that the small-momenta singularity of the momentum distribution present in the low-temperature phase gives an anomalous contribution to the high-energy neutron scattering, and its temperature dependence is very similar to the one expected in the case of scattering by a system with Bose–Einstein condensation and to the experimental data on bulk liquid ^{4}He. It is suggested that ^{4}He in a porous medium with an appropriate statistical distribution of pore size has an intermediate phase, characterized by an "infinite susceptibility," between the high-temperature normal phase and the low-temperature phase with Bose–Einstein condensation. (auth)

35334 PHASE TRANSITION WITHOUT LONG-RANGE ORDER IN TWO DIMENSIONS. Mikeska, Hans-Juergen Max von Laue–Paul Langevin, Garching, Ger.); Schmidt, Hartwig. J. Low Temp. Phys.; 2: 371-81(Apr-May 1970).

As a contribution to the problem of sharp phase transitions in such two-dimensional systems for which the absence of long-range order at any finite temperature has been proved, the structure function of a harmonic crystal, the conductivity of a two-dimensional superconductor, and the magnetic susceptibility for a planar ferromagnet were investigated. Only approximations that satisfy the condition of no long-range order are used, and it is found that this does not exclude qualitative differences between a quasi-ordered low-temperature phase and a usual disordered high-temperature phase. The Bragg scattering peaks of a crystal turn out to be only slightly weakened as compared to the usual δ-function spikes of the structure function. In the frame of the Ginzburg–Landau theory, the conductivity of a two-dimensional superconductor exhibits a δ-function singularity at zero frequency that has the same strength as that in the three-dimensional case. Thus, it is concluded that the absence of long-range order is not sufficient to exclude phase transitions in two-dimensional systems. Finally criteria for two-dimensional behavior of thin slabs of superconducting material are discussed. (auth)

35335 SONICALLY INDUCED CAVITATION OF LIQUID HELIUM. Jarman, P. D.; Taylor, K. J. (Univ. of Western Australia, Nedlands). J. Low Temp. Phys.; 2: 389-402(Apr-May 1970).

The onset of sonically induced cavitation in liquid helium at frequencies between 30 and 40 kHz was studied. In helium II, two types of cavitation activity were identified: acoustic cavitation whose characteristic noise can be detected, and visible cavitation in which vaporous cavities grow to visible size. The onset of acoustic cavitation is statistical in nature with increasing event rates as the sound pressure amplitude is increased and whose threshold depends on the waiting time at that particular amplitude. The acoustic-threshold sound-pressure amplitude in helium II between 1.8°K and T_λ was found to lie within 0.15 mb of 0.3 mb, the variation of ±0.15 mb occurring from one determination to another, whereas the sound-pressure amplitude corresponding to the visible threshold was about a hundred times larger. These two distinct types of sonically induced cavitation appear to be unique to liquid helium. However, above T_λ, the two thresholds were found to coincide at a sound-pressure amplitude within 0.4 mb of 0.8 mb. The characteristics of the onset of acoustic cavitation were found to be independent of applied static pressure of up to 1.5 atm above and below T_λ and in helium II they were unaffected by filtering, heat flushing, or rotating the liquid. The results suggest that liquid helium is nucleated by random events initiated by the ambient cosmic radiation or by vortices generated in the liquid, and they imply that at ultrasonic frequencies this liquid cannot withstand a tensile stress and behaves in this respect like water saturated with gas and containing dust motes. Attempts to determine the onset of acoustic cavitation by scattering light off the bubbles or by detecting sonoluminescence were not successful: The upper limit to the size of these bubbles was shown to be about 30 μm and the intensity of any sonoluminescence must have been less than 10^{-4} of that from cavitating water. The possibilities of exploiting the two types of cavitation activity in liquid helium in the construction of a post-triggerable ultrasonic bubble chamber for visualizing the tracks of ionizing particles are discussed, as are the theoretical background and future development of the work presented in this paper. (auth)

35336 COMPRESSIONAL COOLING OF ^{3}He TO MILLI-DEGREE TEMPERATURES. Johnson, R. T.; Wheatley, J. C. (Univ. of California, San Diego, La Jolla). Contract AT(11-1)-34. J. Low Temp. Phys.; 2: 423-48(Apr-May 1970).

Adiabatic compressional cooling of a two-phase mixture of solid and liquid ^{3}He was studied. Details of the experimental arrangement are given. Using a flexible elastic low-temperature ^{3}He cell compressed by liquid ^{4}He and precooled by a continually operating dilution refrigerator, cooling to below 2 m°K was obtained from starting temperatures near 20 m°K. Frictional heating is remarkably low. Calculations are presented that investigate the fraction of solid formed and that suggest rather long thermal equilibrium times in the solid ^{3}He nuclear-spin system. Application of the method to the production of bulk polarized ^{3}He nuclei is discussed. (auth)

35337 QUASI-PARTICLE INTERACTIONS AND THE BOSE–EINSTEIN PHASE TRANSITION. Novaco, Anthony D. (Battelle Memorial Inst., Columbus, Ohio). J. Low Temp. Phys.; 2: 465-81(Apr-May 1970).

A strongly interacting Bose gas is studied in an attempt to understand the effects upon the physics of the phase transition of the interactions between the higher momentum excitations. At densities an order of magnitude below liquid helium, it is found that these interactions are affecting the phase transition in a manner reminiscent of the effects of roton–roton interactions upon the lambda transition. Singularities in the specific heat and infinite slope at the transition temperature for the superfluid density are found. (auth)

35338 UNUSUAL STRAIN DEPENDENCE OF T_c AND RELATED EFFECTS IN A-15 SUPERCONDUCTORS. Testardi, L. R.; Kunzler, J. E.; Levinstein, H. J.; Wernick, J. H. (Bell Telephone Labs., Inc., Murray Hill, N. J.). Solid State Commun.; 8: 907-11(Jun 1970).

High-temperature (A-15) superconductors have transition temperatures that are remarkably sensitive to interatomic spacings. This prediction, based on velocity of sound measurements and a thermodynamic theory, explains much of the "anomalous" behavior of these superconductors as well as the large changes in T_c with alloying. (auth) (UK)

35339 PRESSURE DEPENDENCE OF THE PAIR-BREAKING PARAMETER OF SUPERCONDUCTORS WITH Ce IMPURITIES. Maple, M. B.; Huber, J. G.; Kim, K. S. (Univ. of California, San Diego, La Jolla). Solid State Commun.; 8: 981-5(1970).

The Abrikosov–Gor'kov pair breaking parameter is shown as a function of pressure (P) for superconducting $La_{1-x}Ce_xIn$ and $La_{1-x}Ce_x$ alloys. This gives an estimate of the quantity $[dlnN(E_F)J^2_{eff}/dP]_{P=0}$ (where $N(E_F)$ is the density of states at the Fermi level and J_{eff} is the effective s–f exchange parameter), and suggests that the transition of the Ce impurities from a magnetic to a nonmagnetic state begins at lower pressures for higher Ce concentrations. Measurements of the pressure dependence of the superconducting transition temperature of $Th_{1-x}Ce_x$ alloys indicate that the Ce impurities are nearly nonmagnetic in Th. (auth) (UK)

35340 SWITCHING OF A SUPERCONDUCTIVE THIN-FILM BRIDGE BETWEEN THE PURE SUPERCONDUCTIVE AND RESISTIVE-SUPERCONDUCTIVE STATES. Seraphim, G. R. S.; Solymar, L. (Oxford Univ.). Electron. Lett.; 6: 289-91(30 Apr 1970).

Experimental results are presented showing that a superconductive thin-film bridge has two stable states, and it is possible to switch from one to the other with the aid of an applied magnetic field. (auth) (UK)

35341 ENHANCEMENT OF SUPERCONDUCTIVITY IN THIN ALUMINUM FILMS. Cherney, O. A. E.; Shewchun, J. (McMaster Univ., Hamilton, Ont.). Can. J. Phys.; 47: 1101-6(15 May 1969).

The results of superconductive tunneling measurements are presented, on very thin (35 to 80 Å) aluminium films which exhibit enhanced transition temperatures T_c up to 2.16°K, and also exhibit a unique energy gap. Stability of the enhanced T_c films is attained by investigating the films in a vacuum; however, upon breaking vacuum, oxide growth occurs, and the tunneling barrier becomes impenetrable. The temperature dependence of the energy gap is BCS-like, and the BCS gap parameter $2\Delta(0)/k_BT_c$ lies within experimental error of the usual BCS value of 3.528 for a weakly coupled superconductor. Existing theories of the enhancement of T_c are discussed in the light of present experimental evidence. However, it is found that none are capable of explaining reasonably the experimental data accumulated to date. It appears that all thin film systems reported to date as having shown an enhancement of T_c are basically the same. Electron microscope photomicrographs show that, structurally, the films are composed of crystallites having a wide range of sizes. Any new theory will have to contain a volume density of such crystallites as a key parameter in determining the enhanced T_c of the film. (auth)

35342 LAMBDA-TEMPERATURE DEPRESSION IN ROTATING LIQUID HELIUM. Brouwer, W. (Univ. of Alberta, Edmonton); Pathria, R. K. Can. J. Phys.; 47: 1941-4(15 Sep 1969).

The depression of the transition temperature is calculated on the basis of the increased inertial density of excitations in a rotating medium. The result obtained is more general than, and under special conditions reduces to, the previous results derived by Andronikashvili, Mamaladze, and co-workers. (auth)

35343 EFFECT OF FLUCTUATIONS ON THE DEPENDENCE OF THE JOSEPHSON CURRENT ON MAGNETIC FIELD STRENGTH. Yanson, I. K. (Physical-Technical Inst. of High Temperature, Kharkov). Zh. Eksp. Teor. Fiz.; 58: 1497-1510 (May 1970). (In Russian).

The anomalous dependences of the critical Josephson current on magnetic field strength are investigated for Sn–Sn junctions. It is shown that the peculiarities observed are due to thermal fluctuations and inhomogeneities of the barrier layer (structural fluctuations). The influence of binding energy, junction temperature, and external circuit resistance on shape of the $I_c(H)$ characteristics is studied. Both thermal and structural fluctuations can lead to a decrease of the oscillation amplitude $I_c(H)$, which is more rapid than $1/H$. However, if thermal fluctuations destroy the superconductivity of the junction, the structural fluctuations will lead to the appearance of a "background" superconducting current that only weakly depends on the magnetic field strength. (auth)

35344 EFFECTIVE RESISTANCE OF AN IMPERFECT TYPE-II SUPERCONDUCTOR IN AN OSCILLATING MAGNETIC FIELD. Andrianov, V. V.; Zenkevich, V. B.; Kurguzov, V. V.; Sytchev, V. V.; Ternovskii, F. F. (Inst. of Low Temperature, Moscow). Zh. Eksp. Teor. Fiz.; 58: 1523-31(May 1970). (In Russian).

The effect of an external oscillating magnetic field on the direct current flowing in an imperfect superconductor of the second kind is investigated. It is found that when the variable component of the external field amplitude exceeds a certain threshold value an effective direct-current resistance arises. The dependence of this quantity on oscillating field frequency, amplitude of variable component, magnitude of constant component and value of direct current flowing in the superconductor is determined. The dependence of the threshold amplitude of the external field on current and field strength is investigated. A theory is proposed which explains the experimental results. (auth)

35345 PHENOMENOLOGICAL THEORY OF SUPERFLUIDITY OF HELIUM NEAR THE λ POINT. Slyusarev, V. A.; Strzhemechnyi, M. A. (Physical-Technical Inst. of High Temperature, Kharkov). Zh. Eksp. Teor. Fiz.; 58: 1757-64(May 1970). (In Russian).

Equations describing the behavior of the order parameter Φ in superfluid helium near the λ point are investigated by scaling methods in the theory of phase transitions. Restrictions imposed on the form of the equations are found. It is shown that the differential equations for Φ are valid only for some certain values of the critical parameters. (auth)

35346 SOUND ABSORPTION IN A SUPERFLUID LIQUID UNDER CONDITIONS OF DAMPING OF THE NORMAL COMPONENT. Karchava, T. A.; Sanikidze, D. G. (Inst. of Cybernetics, Kiev). Zh. Eksp. Teor. Fiz.; 58: 1843-7(May 1970). (In Russian).

The absorption coefficients of first and second sound in superfluid helium related to surface and volume dissipative effects, under the specific conditions of propagation of sound in narrow channels involving damping of the normal component of the liquid, are calculated. It is shown that the contribution of various dissipative processes to sound absorption depends on the degree of damping of the normal component. (auth)

35347 MAGNETIC SURFACE LEVELS IN A SUPERCONDUCTOR. Blank, A. Ya. (Inst. of Theoretical Physics, Moscow). Zh. Eksp. Teor. Fiz.; 58: 1862-70(May 1970). (In Russian).

It is shown that finite motion of single-particle excitations in a magnetic field near a superconductor surface may lead to the existence of a comparatively large number of discrete quantum levels located below the energy gap. The quasi-classical problem of surface excitations is solved and the spectrum of the excitations is found. The results are illustrated by computer calculations. (auth)

35348 COPPER FOIL HEAT EXCHANGERS FOR DILUTION REFRIGERATORS. Roubeau, P. (CEN, Saclay, France). Cryogenics; 10: 255-6(Jun 1970).

A detailed description is given of compact heat exchangers that satisfy recognized design requirements. These are that the exchange area must be as large as is practicable, there must be adequate heat conduction between both sides of of the heat transfer exchanger, the dead volume must be small in order to keep operating time constants short and there must be low flow impedance, especially on the dilute side at very low temperature. Three heat exchangers as described which have on each side an area of 100 cm^2, a flow impedance of about 10^7 cm^{-3} and a dead volume of 0.1 cm^3 were mounted at the cold end of a concentric tube continuous heat exchanger in a dilution refrigerator, with a throughput of 10 μmole of ^3He per second. The temperature of the continuous heat exchanger was found to be 219 mK. Typical body temperatures of the three lumped heat exchangers were 104, 72, and 47 mK. The dilution chamber, which was of similar design, reached a temperature of 25 mK. (UK)

35349 ^3He DILUTION CRYOSTAT FOR OPERATION IN MILLIDEGREE REGION. Peshkov, V. P. (Inst. for Physics Problems, Moscow). Cryogenics; 10: 250-3(Jun 1970).

^3He dilution cryostats in which ^3He passes from one liquid phase rich in ^3He, to another rich in ^4He, are coming into ever increasing use in cryogenic practice. An apparatus which maintains a temperature down to 40 to 60 mK in continuous operation, and in a single operation reaches a few mK is described. (auth) (UK)

35350 EVIDENCE FOR THE VALIDITY OF THE LANDAU THEORY OF LIQUID ^3He. Widom, Allen; Sigel, James L. (Northeastern Univ., Boston). Phys. Rev. Lett.; 24: 1400-2 (22 Jun 1970).

It is observed that the Landau theory of liquid ^3He makes a definite prediction about the behavior of the liquid structure factor $S(k)$ when $\hbar k \ll P_F$. Using the two-parameter Ansatz $F(\chi) = F_0 + F_1P_1$ (cos χ) for the spin-symmetric part of the quasiparticle interaction function with F_0 and F_1 determined by zero sound and compressibility, a qualitatively good fit to recent x-ray data for $S(k)$ is obtained. (auth)

35351 THICKNESS OF THE FLOWING SUPERFLUID FILM. Goodstein, D. L.; Saffman, P. G. (California Inst. of Tech., Pasadena). Phys. Rev. Lett.; 24: 1402-5(22 Jun 1970).

It has recently been shown experimentally that the thickness of a saturated helium film is independent of its state of superflow. A simple model is presented here in which the thickness of such a film is fixed for dynamical considerations at the gas/film interface, and the required balance of forces is then provided by relatively minor adjustments in the film surface tension. (auth)

35352 EXPANSIONS OF THE FREE ENERGY NEAR A PHASE TRANSITION. Amit, Daniel J. (Brandeis Univ., Waltham, Mass.). J. Phys. Chem. Solids; 31: 1099-1111(May 1970).

A phenomenological theory describing the uniform and nonuniform properties of a system near a critical point is proposed. This theory allows for quite general exponents satisfying certain relations, e.g., scaling relations. The form of the expansion in powers of the order-parameter is different from previous attempts to generalize the Landau–Ginzburg theory. This change in the form of the expansion allows for the allocation of a well-defined region in the order-parameter temperature plane in which the theory is expected to be a good approximation. The expectation is reinforced by a recent experiment of Ho and Litster. The proposed expansion includes in a natural way a possible logarithmic divergence in the specific heat without affecting other properties with logarithm terms. The determination of the parameters

in the theory is discussed both for cases in which the order parameter is experimentally accessible and for cases, like the superfluid, in which it is not accessible. (auth) (UK)

35353 FORCE-COOLED SUPERCONDUCTING SYSTEMS. Keilin, V. E.; Klimenko, E. Yu.; Kovalev, I. A.; Samoilov, B. N. (Inst. of Atomic Energy, Moscow). Cryogenics; 10: 224-32 (Jun 1970).

Force-cooled superconducting systems (fcss) are compared with traditional "pool" systems. A model is proposed to determine the stability criteria for current in fcss and some results of the analysis of this model are presented. A force-cooled superconducting coil and the apparatus to test the coil, built in IV Kurchatov Atomic Energy Institute during 1968, are described. The results of the tests on the coil are also presented. (auth) (UK)

35354 100-kOe SUPERCONDUCTING COIL MAGNET. Metselaar, J. W.; Jordaan, H. A.; Schutter, J. W.; de Klerk, D. (Kamerlingh Onnes Laboratorium, Leiden). Cryogenics; 10: 220-3(Jun 1970).

The construction of a superconducting coil magnet for 100 kOe (80×10^5 A m^{-1}) maximum field, 28 mm clear bore, is described. Different types of wire were used in the coil in order to keep the field relatively low. On testing the coil the quench field was found to be 114 kOe at 1.5 K and 87 A magnet current. Details about flux jumps, homogeneity, and field measurement are given. Also described is the construction of a simple stainless steel cryostat which has an evaporation rate of about 0.35 l h^{-1} LHe, including the heat input from a pair of optimized cryogenic leads for the magnet current. (auth) (UK)

35355 INTERACTION BETWEEN ELECTRONS AND MOVING DISLOCATIONS IN SUPERCONDUCTORS. Huffman, G. P.; Louat, N. (US Steel Corp. Research Center, Monroeville, Pa.). Phys. Rev. Lett.; 24: 1055-9(11 May 1970).

The interaction between a moving dislocation and the electrons in a superconductor is treated theoretically. The results are in qualitative agreement with recent measurements of flow stress in superconductors. (auth)

35356 PAIR TUNNELING AS A PROBE OF FLUCTUATIONS IN SUPERCONDUCTORS. Scalapino, D. J. (Univ. of California, Santa Barbara). Phys. Rev. Lett.; 24: 1052-5(11 May 1970).

The use of the average pair field of one superconductor to probe the fluctuation pair field of a second metal at temperatures above the latter's superconducting transition point is suggested. The two metals should be fabricated as a strongly coupled tunnel junction and the dc I–V characteristic measured as a function of both the bias voltage V and the amplitude of a magnetic field H parallel to the junction interface. The resultant I–V characteristic is predicted to give a direct measurement of the frequency and wave-vector dependence of the Δ susceptibility characteristic of the superconducting transition. (auth)

35357 EFFECT OF STRESS ON THE SUPERCONDUCTING TRANSITION TEMPERATURE OF $SrTiO_3$. Pfeiffer, E. R.; Schooley, J. F. (National Bureau of Standards, Washington, D. C.). J. Low Temp. Phys.; 2: 333-52(Apr-May 1970).

The superconducting transition temperatures of several specimens of reduced $SrTiO_3$ and of Nb-doped $SrTiO_3$ were investigated as functions of hydrostatic and uniaxial compressive stresses up to 1.8 kbars. Decreases in T_c as large as 0.12°K were observed in specimens under hydrostatic pressure. Because of the low T_c and small compressibility of $SrTiO_3$, $\Delta(\ln T_c)/\Delta P$ and $\Delta(\ln T_c)/\Delta(\ln V)$ are orders of magnitude greater than the corresponding effects in elemental superconductors. The effect of uniaxial stress on T_c varied with the direction of stress. Compression along a [111] direction caused large decreases in T_c, while both small increases and small decreases in T_c were observed for [100] compression. It is believed that the present results reveal the presence of a sensitive volume dependence in one or more of the parameters important to superconductivity in $SrTiO_3$, and that no significant electron-transfer effects occurred in the range of stresses of this experiment. (auth)

35358 EVIDENCE FOR FLUCTUATION EFFECTS ABOVE T_c IN ISOTOPICALLY AND METALLURGICALLY PURE BULK TYPE-I SUPERCONDUCTORS. Fassnacht, R. E.; Dillinger, J. R. (Univ. of Wisconsin, Madison). Phys. Rev. Let.; 24: 1059-61 (11 May 1970).

Magnetic measurements of superconducting transitions of very pure isotopically separated bulk samples of Ga and Zn reveal a large "paraconductive" effect. This is contrary to the prediction for such systems by Aslamazov and Larkin based on corrections to first order in the fluctuations in the system. It is suggested that this discrepancy may be explained by increased electron pair lifetimes due to the absence of isotopic and other scattering of phonons allowing higher order processes to be significant. (auth)

35359 NONLOCAL CHARACTERISTICS OF THE BULK UPPER CRITICAL FIELD OF NIOBIUM. Williamson, S. J.; Valby, L. E. (North American Rockwell Corp., Thousand Oaks, Calif.). Phys. Rev. Lett.; 24: 1061-4(11 May 1970).

Measurements of the anisotropic critical field H_{c2} of Nb at temperatures down to 0.06°K show that its temperature dependence contains a logarithmic factor as predicted by Gor'kov on the basis of a nonlocal theory for an isotropic type-II superconductor. The critical field extrapolated to zero temperature, when averaged over all crystallographic directions and normalized to the slope of the critical field $T \approx T_c$, has an enhancement close to that predicted by the Hohenberg–Werthamer calculation for the nonlocal effects of Fermi-surface anisotropy, as evaluated by Mattheiss for a band model of niobium. (auth)

35360 EXPERIMENTAL EVIDENCE FOR A FIRST-ORDER MAGNETIC TRANSITION IN THIN SUPERCONDUCTING ALUMINUM FILMS. Tedrow, P. M.; Meservey, R.; Schwartz, B. B. (Massachusetts Inst. of Tech., Cambridge). Phys. Rev. Lett.; 24: 1004-7(4 May 1970).

The critical magnetic field H_c of aluminum films, 50 to 220 Å thick, was measured at temperatures between 0.4°K and the transition temperature. For the thinnest films, a qualitative change in the form of the transition for $T/T_c < 0.5$ indicates the presence of the first-order phase transition predicted for paramagnetically limited superconductors. The results also seem to demonstrate the existence of fluctuation broadening at higher temperatures. (auth)

35361 PHONON CONTRIBUTION TO THE FAR-INFRARED ABSORPTIVITY OF SUPERCONDUCTING AND NORMAL LEAD. Joyce, R. R.; Richards, P. L. (Univ. of California, Berkeley). Phys. Rev. Lett.; 24: 1007-11(4 May 1970).

Low-temperature measurements of the absorptivity of superconducting and normal Pb in the phonon frequency region 15–200 cm^{-1} show an onset of absorption when the photon energy is large enough to excite appreciable numbers of acoustic phonons. The onset begins around the transverse phonon frequency $\Omega \simeq 35$ cm^{-1} in the normal metal and around $\Omega + 2\Delta \simeq 55$ cm^{-1} in the superconductor. Most features of the data can be explained by a "Golden Rule" calculation of the phonon-generation process proposed by Holstein. (auth)

35362 DIRECT MECHANICAL MEASUREMENT OF PINNING FORCES IN TYPE-II SUPERCONDUCTORS. Eggendorfer, G. (Zentralinstitut fuer Tieftemperaturforschung, Garching, Ger.). Phys. Status Solidi (a); 2: K55-8(16 May 1970).

Pinning forces on flux vortices may be measured by means of the mechanical force acting on the superconductor just before the vortices start to flow and energy dissipation occurs. The experimental arrangement includes a Corbino disc and a torsion pendulum, whose torque is measured optically. Preliminary results for a Nb sample give the average pinning force per unit length of a vortex, $k = 16 \times 10^{-18}$ dynes cm. (D.L.C.)

35363 FLUX FLOW VELOCITY IN SUPERCONDUCTING FILMS BY MEASUREMENT OF PASSAGE TIME. Meissner, Hans (Stevens Inst. of Tech., Hoboken, N. J.). J. Low Temp. Phys.; 2: 267-89(Apr-May 1970).

The velocity of flux tubes in thin superconducting films was determined by measuring the time for their passing across the film. A legion of flux tubes was pulsed in on the left side of a film carrying a current large enough to break the pinning. The arrival of the flux tubes on the right side is observed with a pick-up coil. Flow velocities of 3 to 50×10^4 cm/sec were observed with current densities up to 10^5 A/cm^2. (auth)

35364 SUPERCONDUCTING PROPERTIES AND THE PHASE DIAGRAMS OF THE Pb–Bi AND Pb–In ALLOY SYSTEMS. Evetts, J. E.; Wade, J. M. A. (Cambridge Univ., Eng.). J. Phys. Chem. Solids; 31: 973-82(May 1970).

Magnetisation measurements were made at 4.2°K on Pb–Bi and Pb–In alloys over a wide range of compositions. The resulting data for the variation with composition of the three critical fields and kappa is presented. For both alloy systems the superconducting measurements prove to be a powerful method for resolving uncertainties in the phase diagram. (auth)

35365 NEW SUPERCONDUCTING MODIFICATIONS OF BISMUTH. Il'ina, M. A.; Itskevich, E. S. (Inst. of High-Pressure Physics, Moscow). JETP Lett. (USSR)(Engl. Transl.); 11: 218-21(5 Apr 1970).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 11: 328-32 (5 Apr 1970).

The superconducting properties of the high-pressure forms of Bi were investigated in the pressure range 30 to 100 kbar. Bi III has $T_c = 7.00$°C at 27 kbar and $dT_c/dP = -(4 \pm 0.5) \times 10^{-5}$ deg/bar.

Bi IV has $T_c = 7.0°K$ at 43 kbar and $dT_c/dP = -(4.6 \pm 0.5) \times 10^{-5}$ deg/bar. Bi V has $T_c = 6.7°K$ at 68 kbar and $dT_c/dP = -(3 \pm 0.5) \times 10^{-5}$ deg/bar. Finally, for Bi VI $T_c = 8.55°K$ at 90 kbar and $dT_c/dP = -(2.3 \pm 0.5) \times 10^{-5}$ deg/bar. It is concluded that the superconducting transition is a good test for detecting polymorphic transformations. (D.L.C.)

Plasma and Thermonuclear Physics

35366 MICROWAVES. Baden Fuller, A. J. The Commonwealth and International Library. New York; Pergamon Press, Inc. (1969). 302p. $7.50.

Chapters are included on the following: (1) transmission lines, (2) electromagnetic fields, (3) waveguide transmission, (4) rectangular waveguides; (5) circular waveguides, (6) conducting media, (7) ferrite media, (8) plasma and electron beam, (9) oscillators and amplifiers, (10) components, (11) devices, and (12) measurements. A separate abstract was prepared for the chapter on plasma and electron beams. (M.O.W.)

For an abstract of one chapter see: 35415.

35367 PLASMA PHYSICS INDEX. VOLUME 5, NO. 5, 1970. Bibliography, Author Index, Subject Index. Frankfurt am Main; Zentralstelle fuer Atomkernenergie-Dokumentation (1970). 97p.

The listing includes 437 articles on various aspects of plasma physics. (M.O.W.)

35368 FIZIKA PLASMY. VYP. 2. SBORNIK STATII. (Plasma Physics. Issue 2. Collection of Articles). Luk'yanov, S. Yu. (ed.). Moscow; Atomizdat (1969). 112p.

Eleven articles are included on problems of controlled thermonuclear fusion, plasma interactions, and charged-particle interactions with solids. Ion acceleration in crossed electric and magnetic fields, ultrathin graphite foils for measuring ion energy distribution in high-temperature plasma, production of strong pulsed magnetic fields, simulation of gas plasma in semiconductors, and the influence of diffusion and losses on the energy spectrum of relativistic electrons are among the topics discussed. (R.V.J.)

Confinement and Heating

Refer also to abstract 35445.

35369 (AD-703284) COMPUTER SIMULATION OF PLASMA INJECTION AND TRAPPING IN A LINEAR OCTUPOLE. Cardwell III, George L.; Duesterhoeft, W. C. (Texas Univ., Austin. Electronics Research Center). 15 Oct 1969. 148p. (TR-79; AFOSR-70-230-TR). CFSTI.

The plasma model used in the simulation is a particle-like model. Several restrictions are placed on the model in order that it faithfully simulate the plasma. These restrictions are discussed in detail. The motion of the particles is determined by Newton's equation of motion and the Lorentz force law. The difficulties involved in computing the Coulomb interaction of the particles are discussed. An alternative procedure for computing the electrostatic-particle interactions by solving Poisson's equation is presented. A technique for machine solution of Poisson's equation is described in detail. The method is a modification of the technique given by Hockney. The computer techniques are applied to the study of the injection and trapping of a plasma in a linear octupole. The results of this analysis are presented and compared with the experimental results of Boyd. Physical arguments are given to explain the analytically and experimentally observed phenomena. (auth) (USGRDR)

35370 (ORNL-TM-3036) TURBULENT ION HEATING IN BURNOUT V. Widner, M. (Oak Ridge National Lab., Tenn.). Jul 1970. Contract W-7405-eng-26. 18p. Dep. CFSTI.

Some of the fundamental equilibrium properties, such as dc electric fields and cross-field drifts, are calculated for Burnout V. The probable ion-heating mechanism, an instability resulting from a relative cross-field drift between ions and electrons, is evaluated, predicting growth rates on the order of ω_{pi}. (auth)

35371 (RLO-1548-23) VACUUM AND SURFACE STUDIES CONCERNING PLASMA ENVIRONMENTS. Annual Summary, June 1969-June 1970. Donaldson, E. E.; Dresser, M. J. (Washington State Univ., Pullman. Dept. of Physics). Contract AT(45-1)-1548. 30p. Dep. CFSTI.

Studies are described in the following order: (1) ion burial and thermal release from niobium single crystals, (2) electron impact desorption, (3) adsorption and total uptake of hydrogen by niobium, (4) scattering of molecules from surfaces, and (5) etching reactions at surfaces. (M.O.W.)

35372 (UCB-34-P-128-14) FOURTH QUARTERLY PROGRESS REPORT OF 1969 ON PLASMA RESEARCH, OCTOBER 1-DECEMBER 31, 1969. (California Univ., Berkeley. Electronics Research Lab.). Contract AT(11-1)-34. 77p. Dep. CFSTI.

Research was concerned primarily with the problems of creating, containing, and heating high-temperature plasmas. The research involves studying the physical and electromagnetic properties, stability, and radiation of these plasmas. A low-temperature plasma is used as an analogue to study the stability of high-temperature plasmas. The high-temperature plasma research facility consists of a 250,000-joule capacitor energy-storage bank and related control system. The bank serves either of two magnetic-mirror compression experiments that require peak magnetic fields in excess of 50,000 gauss. The low-temperature plasma facility is an alkali-metal vapor plasma device. It is used to study the stability of low-temperature plasmas in various magnetic field and plasma configurations, in a density regime that approximates a number of features of a high-temperature plasma. Complementary to the experiments are a wide range of theoretical studies. Computer experiments in one, two, and three dimensions are used to study both many-body systems and nonlinear systems as initial-value problems; this form of simulation produced a number of results not obtainable analytically and prior to experimental observation. Other theoretical work includes the dynamics of single particles and solution of linear dispersion relations. (auth)

35373 EFFECT OF LOW-FREQUENCY OSCILLATIONS ON RADIAL DISTRIBUTION OF CONCENTRATION AND ESCAPE OF CHARGED PARTICLES ACROSS MAGNETIC FIELD IN THE HOT CATHODE PENNING DISCHARGE. Gabovich, M. D.; Naumovets, V. G.; Romanyuk, L. I.; Slobodyan, V. M. (Kiev Inst. of Physics). Ukr. Fiz. Zh.; 15: 543-50(Apr 1970). (In Russian).

Experimental data are obtained on momentary and time-averaged radial distribution of plasma concentration in the hot-cathode Penning discharge in the presence of low-frequency oscillations with azimuthal modes m = 1, 2, 3 and in the absence of them. Comparison of the experimental time-averaged radial distributions of plasma density with calculated ones was carried out. It was shown that onset of low-frequency oscillations not only with azimuthal mode m = 1, but also with m = 2 and m = 3, contributes to the increase of charged-particle escape across the magnetic field. (auth)

35374 CLASSICAL DIFFUSION IN A TOKAMAK. Grad, Harold; Hogan, John (New York Univ., N. Y.). Phys. Rev. Lett.; 24: 1337-40(15 Jun 1970).

Analysis of the simplest classical model for resistive diffusion in an axially symmetric Tokamak geometry shows that present experiments are in a transitional regime which requires analysis of the interaction between several distinct, nonlinearly coupled, transient processes. A few consequences of this theory are examined, and a limiting steady state with much simpler scaling is described. (auth)

35375 TURBULENCE AND ELECTRON HEATING DURING BEAM INSTABILITY. Astrelin, V. T.; Buchel'nikova, N. S.; Drozdov, A. A.; Kudryavtsev, A. M. (Inst. of Nuclear Physics, Novosibirsk, USSR). Zh. Eksp. Teor. Fiz.; 58: 1553-66(May 1970). (In Russian).

High-frequency plasma wave instability excited by an electron beam in a radius-restricted plasma is investigated experimentally. The space-time correlation functions of the high-frequency oscillations are measured and the ϕ_{kw}^2 spectra for various operating conditions are determined on their basis. Nonresonant plasma electron heating is observed and its relation to the oscillation spectrum ϕ_{kw}^2 is investigated. The heating mechanism is shown to be stochastic. (auth)

35376 DIFFUSION OF PLASMA IN TOROIDAL SYSTEMS. Kadomtsev, B. B.; Pogutse, O. P. Zh. Eksp. Teor. Fiz.; 58: 1675-82(May 1970). (In Russian).

Turbulent diffusion of a plasma developing as a result of gravitational dissipative instability in toroidal systems is considered. Expressions for the diffusion and thermal conductivity coefficients are obtained in the case of small and large values of the electron collision frequencies. The diffusion and thermal conductivity coefficients are found to be appreciably higher than the classical values. Diffusion of a plasma in the case of weak destruction of magnetic surfaces is also considered. (auth)

35377 PRELIMINARY EXPERIMENT ON THE PLASMA CONFINEMENT IN THE HELIOTRON FIELD WITH BURIED RING CONDUCTORS. Mohri, Akihiro; Matsuda, Shinsaburo; Uo, Koji (Kyoto Univ.). Mem. Fac. Eng., Kyoto Univ.; 32: 78-92(Jan 1970).

In order to restore the plasma stability in the Heliotron-C mag-

netic field, the Heliotron-P field, which has buried ring conductors inside the vacuum vessel and thus avoids the cusp losses, has been proposed. As a preliminary experiment on the plasma confinement in this field, the plasma behavior in a mirror field having a current-carrying ring conductor, which corresponds to the one section of the Heliotron-P field, is investigated. The plasma injected from a gun into this field rapidly fills up the region near the separatrix showing the existence of the magnetic well. The plasma ($T_e \approx 20$ eV, $n \leq 10^{11}$) is stably confined in this field. The predominant loss in the mirror end loss, and the net radial loss time is inferred to be 1.4 msec. Drift instability is observed only in the region of the steep density gradient at the plasma periphery. (auth) (NSA of Japan)

35378 TEMPERATURE GRADIENT EFFECTS AND PLASMA CONFINEMENT IN A Q-DEVICE. Guilino, Ernst (Institut fuer Plasmaphysik GmbH, Garching, Ger.). Phys. Fluids; 13: 1865-65(Jul 1970).

Azimuthal components of the electric field in Q-machine plasmas may occur if the distribution of temperature over the end plates deviates from rotational symmetry. In this case, $E_\theta \times B_z$ drifts give rise to plasma loss rates which may be comparable in magnitude to Bohm diffusion. This effect is verified experimentally in a double-ended Q machine. A new heater system for the end plates using rotating cathodes yields temperature distributions which are symmetrical within less than 0.1%. Under these conditions the loss rate is reduced by a factor of 10 to 60 as compared to operation with conventional heater systems. (auth)

35379 ENERGY-BALANCE EQUATION AND ENHANCED COLLISIONAL PLASMA DIFFUSION. Wimmel, H. K. (Institut fuer Plasmaphysik, Garching, Ger.). Nucl. Fusion; 10: 117-22(Jun 1970).

An exact energy-balance equation is derived from the first-order moments of the ion and electron transport equations. In this case, the particle loss of a stationary plasma through an isobaric surface is expressed as the sum of several terms each of which contains a specific force (E-field, collisional friction, anisotropic pressure including inertial terms). The equation provides a general frame of interpretation for any stationary diffusion process or loss mechanism of a plasma. In particular, it is shown that Galeev–Sagdeev diffusion in an axisymmetric torus cannot be explained by the friction term ηj^2 or the Joule term $\vec{E} \cdot \vec{j}$, but comes about by pressure anisotropy. This result rests on the assumption that the perpendicular resistivity $\eta_\perp$ is not altered in order of magnitude by the presence of trapped particles, an assumption that is plausible from recent work by Hinton and Oberman. For Tokamak-like parameters the effective pressure anisotropies required for explaining Galeev–Sagdeev diffusion are very small, of the order of 10^{-3} to 10^{-6}. (auth)

35380 IMPROVEMENTS IN OR RELATING TO PLASMA CONTAINMENT SYSTEMS. Taylor, John Bryan (to United Kingdom Atomic Energy Authority). British Patent 1,192,380. 20 May 1970. Filed 14 Dec 1966.

The requirements for magnetic field configurations for the containment of a hot plasma are outlined, and some disadvantages of existing systems are mentioned. In the system described the containment system comprises a toroidal structure, means for generating a magnetic field configuration comprising at least one conductor which when energized generates a magnetic field the lines of which form toroidal loops closed upon themselves, and an arrangement of further conductors which when energized transform the magnetic field rotationally; the latter conductors are arranged anti-symmetrically about a plane containing the major axis of the structure. The first-mentioned conductor may comprise a solenoid winding on the toroidal structure, and the further conductors may comprise multiple helical windings encircling the toroidal structure in opposite senses of the halves of the toroidal structure on either side of the aforementioned plane. The further conductors may include a conductor on the minor axis of the toroidal structure, this conductor having current feed conductors extending into the toroidal structure at opposite points in the plane. (UK)

Diagnostics

Refer also to abstract 35483.

35381 (AD-702760) EXPERIMENTAL INVESTIGATIONS ON POSITRON ANNIHILATION IN A PLASMA. Final Technical Report (Part III). Lohnert, Gunther H.; Schneider, Richard T.; Schikorr, Michael W. (Florida Univ., Gainesville. Dept. of Nuclear Engineering Sciences). 1 Jan 1970. Contract Nonr-580(19). 59p. CFSTI.

The fact that electron–positron annihilation can be used to measure basic plasma properties as electron density, electron temperature and velocity distribution of the electrons is discussed. Slow positrons (<1 keV) are required. Design and construction of a positron gun capable of generating a beam of slow positrons is described. As a positron source, ^{22}Na or ^{58}Co can be used. The counting system is outlined. It is intended to apply the gun to a plasma chamber for demonstration of the feasibility of electron–positron annihilation as a plasma diagnostic tool. The design of the plasma chamber is discussed. (auth) (USGRDR)

35382 METHOD OF DETERMINING ION TEMPERATURES IN LASER-PRODUCED PLASMAS. Allen, F. J. (Ballistic Research Labs., Aberdeen Proving Ground, Md.). J. Appl. Phys.; 41: 3048-51(Jun 1970).

A method is derived for obtaining ion temperatures in a plasma produced by irradiation of a solid target with a Q-switched laser beam. Ion temperatures are then obtained from published data. For an incident intensity of 6×10^{10} W/cm^2, ion temperatures in the range of 10 to 40 eV are found. These values are consistent with values of electron temperatures found by others. (auth)

35383 EXACT FIELDS OF A PULSED DIPOLE IN A HOMOGENEOUS COLD PLASMA. Wait, James R. (Univ. of Colorado, Boulder). J. Appl. Phys.; 41: 2880-4(Jun 1970).

The well-known time-harmonic field expressions for a dipole in a cold plasma are generalized to the transient or nonsteady situation. Specifically, a Hertzian dipole excited by both a constant and sinusoidal current turned on at t = 0 was considered. It is found that the early part of the waveform behaves in a manner fundamentally different from the steady-state response. (In spite of the simplicity of the model, it appears that the results are novel.) (auth)

35384 ELECTRON TEMPERATURE MEASUREMENT IN PLASMA–BEAM DISCHARGE LASER THROUGH THE BREMSSTRAHLUNG X-RAY SPECTRUM. Gadetskii, N. P.; Bolotin, L. I.; Tkach, Yu. V.; Bessarab, Ya. Ya.; Magda, I. I.; Bogdanovich, A. V. (Physical Technical Inst., Kharkov). Ukr. Fiz. Zh.; 15: 662-6(Apr 1970). (In Russian).

The high-energy plasma electron temperatures (0.8 to 1 keV) were measured through the bremsstrahlung x-ray spectral distribution. The x-ray absolute intensity measurements showed that the hot electron group density was 10^{10} cm^{-3}. The hot electron temperature and quantity proved to be sufficient to produce the critical population inversion in the plasma–beam discharge laser. (auth)

35385 MICROWAVE DIAGNOSTICS OF A SEMI-INFINITE SHARPLY BOUNDED NONUNIFORM PLASMA. Vlasov, R. A. (Inst. of Physics, Minsk). Dokl. Akad. Nauk BSSR, 13: 110-12 (Feb. 1969). (In Russian).

It is shown that for $\epsilon = 1$ at the boundary of a plasma the free term of the integral equation of Abel is a function of the function $\Psi(\omega)$, which is experimentally measurable by multifrequency probing. For the case of an absorbing plasma, the free term is a function of $\Psi(\omega)$ and $R(\omega)$, where $R^2(\omega)$ is the coefficient of reflection. (tr-auth)

35386 INFLUENCE OF RESONANCES IN ELASTIC ELECTRON SCATTERING BY Li^+ ION ON Li PLASMA PROPERTIES. Propin, R. Kh. (Inst. of Physics, Riga). Latv. PSR Zinat. Akad. Vestis, Fiz. Teh. Zinat. Ser.; No. 2, 30-4(1970). (In Russian).

The resonance influence on the effective number of the electron impacts in a unit of time is considered. The plasma itself, located in a weak alternating electric field, has parameters at which the effect considered is expected to reach the highest level. The effect is found to have a minor influence on the electric properties of the plasma. (auth)

35387 METHOD FOR THE DETERMINATION OF RELATIVE DENSITIES IN A LOW-DENSITY PLASMA BY ELECTRIC PROBES. Eyni, M. (Tel Aviv Univ., Israel); Cuperman, S. Plasma Phys.; 12: 77-81(Jan 1970).

A method is proposed for the determination of relative plasma densities by electric probes, based on the fact that the ion currents to negatively biased probes of different geometrical shapes immersed in a low-density plasma respond differently to variations in the plasma density. (UK)

35388 TEMPERATURE MEASUREMENTS OF A LASER-PRODUCED PLASMA USING THE RECOMBINATION CONTINUUM. Seka, W. (Association Euratom CEA, Fontenay-aux-Roses, France); Breton, C.; Schwob, J. L.; Minier, C. Plasma Phys.; 12: 73-7(Jan 1970).

The light of a Nd glass laser (≈1 J, 30 nsec full width at half

maximum) was focused by a lens of 10 cm focal length onto a solid Al target placed in a vacuum chamber. The resulting plasma was studied spectroscopically in the vacuum-ultraviolet by Schwob et al. (1969). They arrived at an electron temperature of about 25 eV based on the peak of the bremsstrahlung continuum. In this paper, independent temperature measurements are reported from the method of selective transmission of x rays through different absorbing films first described and applied by Jahoda et al. (1960). However, the plasma studied was not fully ionized. For the temperatures observed and for wavelengths below 100 Å, the recombination continuum is larger by one or more orders of magnitude. In addition, this continuum changes its shape quite rapidly with varying electron temperature for 20 and 30 eV. The computed transmission curves as a function of λ for typical absorbers used and for kT_e = 30 eV are shown. The ratio of the transmitted intensities in these two regions is extremely sensitive to small changes in electron temperature; thus it is well suited for temperature measurements. (auth) (UK)

35389 NOTE ON A MICROWAVE REFLECTION PROBE. Funahashi, A.; Takeda, S. (Nagoya Univ., Japan). Plasma Phys.; 12: 70-2(Jan 1970).

Since the proposal of the microwave reflection probe (Takeda and Tsukishima, 1963, 1964), which can measure plasma densities higher than the cutoff from the phase angle of the reflection coefficient at the plasma boundary, several authors have reported the measurements (McLane et al., 1965; Hermansdorfer, 1966; Bobeldijk et al., 1968; Funahashi and Takeda, 1968). Necessary procedures neglected in some of these experiments are pointed out. (auth) (UK)

35390 INTEGRAL PICTURE FILM SHOOTING: TIME EXPOSURE 5 ns. Doittau, F. X. (Societe d'Etudes et Realisations Nucleaires, Suresnes, France; Fabre, E.; Bruneteau, J.; Colburn, S. Onde Elec.; 50: 317-21(Apr 1970). (In French).

An ultraspeed camera of high performance, the first equipment of this kind studied and designed in France, is described. Because of its short time exposure and its high optical resolution, it was used for photographing a plasma immediately after its formation. The pictures show the interaction between the plasma and a magnetic field, and interesting information was obtained about the plasma structure and the spatial modulation of its density. (France)

35391 TEMPERATURE MEASUREMENT OF NEUTRALS IN ARGON PLASMA JET. Cabannes, F. (Centre National de la Recherche Scientifique, Orleans-la-Source, France); Chapelle, J.; Czernichowski, A.; Decroisette, M.; Zamarlick, J. Rev. Int. Hautes Temp. Refract.; 7: 7-14(Jan-Mar 1970). (In French).

In a weakly ionized plasma, the temperature is a main parameter to characterize the plasma state. But spectroscopic methods give generally the electron temperature. The temperature of neutrals can be obtained from interferometric measurements of index up to 5000°K. From 5000°K to 11,000°K, in a laminar plasma jet, the temperature is deduced from dynamic pressure and flow velocity measurements. (France)

35392 AN INVESTIGATION OF HYDRODYNAMIC WAVES WITH A CYLINDRICAL MICROWAVE RESONATOR. III. THE INFLUENCE OF AN AXIAL MAGNETIC FIELD. Curzon, F. L.; Pike, R. L. (Univ. of British Columbia, Vancouver). Can. J. Phys.; 47: 1051-5(15 May 1969).

A microwave resonator was employed to study the damping of a surface wave on mercury in the presence of a vertical magnetic field. The conditions of the experiment satisfy the linearity requirements of the theory and confirm the expected dependence of the damping frequency on magnetic field strength, fluid depth, and radius. (auth) (Canada)

35393 DIRECT MEASUREMENT OF PLASMA SPACE POTENTIAL. Jobes, F. C.; Hickok, R. L. (Mobil Research and Development Corp., Princeton, N. J.). Nucl. Fusion; 10: 195-7 (Jun 1970).

A heavy-ion beam-probe was built using a 1-μA, 12-keV Cs^+ beam, and by electrostatically comparing the Cs^{2+} energy to the accelerator voltage, the space potential of the plasma was measured with a voltage resolution of one volt. (M.O.W.)

35394 FLOATING POTENTIAL OF EMITTING PLASMA PROBES. Biblarz, Oscar (Naval Postgraduate School, Monterey, Calif.); Derfler, Heinrich. J. Phys. Soc. Jap.; 29: 180-6(Jul 1970).

The floating potential of a probe in a high-density seeded plasma is described with the classical electrostatic probe theory extended to include emission. In general, this emission consists of ions, atoms, and electrons. The rate at which these particles are emitted depends on the probe temperature and on its surface coverage by the seed. Since the ion arrival is governed by how the surface floats electrically with respect to the plasma, a coupled situation can exist. The problem is formulated in terms of two-temperature description where plasma electrons retain their temperature as they approach the surface. The theory is developed in general for probes biased to a surface where emission conditions can be known, and then it is specialized to catalytic and noncatalytic surfaces. The noncatalytic situation is correlated with some data for an atmospheric argon plasma seeded with potassium. A computational scheme is used to calculate the equilibrium fluxes from a surface which is absorbing seed. (auth)

35395 USE OF THE LIGHT EMISSION OF THE PLASMA TO INVESTIGATE THE REGULAR AND STOCHASTIC OSCILLATIONS GENERATED BY BEAM INSTABILITY. Lifshits, E. V.; Kornilov, E. A. Zh. Tekh. Fiz.; 40: 996-1004(1970). (In Russian).

Time-related autocorrelation functions of the light emitted by a plasma may be used for the study of the regular and stochastic oscillations induced by various instabilities. The work involved an investigation of the modulation of the light intensity emitted by the plasma within the frequency range from 1 kHz to 1 MHz. The autocorrelation function was determined on the basis of the intensity changes of the emission, measured on the oscillograms. These data, determined on specific spectral lines, were compared to corresponding autocorrelation functions obtained by probes in radiofrequency methods. In view of the good agreement obtained, it was concluded that such optical methods are well suited for the study of stochastic oscillations and are recommended for diagnostics of turbulent plasma. (TTT)

35396 LANGMUIR PROBES AND ION FLOW. Varey, R. H. (Central Electricity Generating Board, Marchwood, Eng.). J. Phys., D (London); 3: 1107-12(Jul 1970).

Plane probes were used to measure plasma density in the positive column of a low-pressure mercury discharge. The results were found to depend on the orientation of the probe face, and it is suggested that this is due to the effects of radial ion flow. It is shown that accurate values for plasma density distribution can be obtained by placing a probe face parallel to the direction of ion flow. (auth) (UK)

35397 MEASUREMENT OF PLASMA ELECTRON DENSITY BY THE LASER SELF-HETERODYNE. Wheeler, C. B.; Dangor, A. E. (Imperial Coll. of Science and Tech., London). J. Phys., D (London); 3: 1122-9(Jul 1970).

A method is described for measuring the electron density of a magnetized plasma by incorporating the plasma in a laser cavity. The two refractive indices of the magnetized plasma force each lasing mode to oscillate at two closely spaced frequencies. These two frequencies can be made to beat with 100% modulation by passing the laser radiation through a polarizer and this beat frequency is independent of the plasma temperature and to first order also independent of mode pattern and mirror vibrations. A full analysis is carried out for the high-gain lasing transitions of neon and carbon dioxide which lase at wavelengths of 3.39 and 10.6 μm respectively. The lowest electron density that can be measured is determined by frequency locking and a tentative figure of 50 Hz is suggested. At a wavelength of 10.6 μm this beat frequency corresponds to an electron density of 4×10^{10} cm^{-3} for a plasma containing an axial field of 10 kG. For smaller fields the density is increased pro rata for the same beat frequency. However, the magnetic field must lie above a certain density dependent limit set by the onset of collisional depolarization. Finally a steady-state experiment is described using a magnetized block of fused quartz inside a laser cavity operated at 3.39 μm wavelength. This experiment shows that the heterodyne technique is perfectly stable and reproducible and also enables the Verdet constant of the dielectric to be accurately measured. (auth) (UK)

35398 MODIFICATION OF ION SHEATH BY ELECTRON-EMITTING PROBE. Rohatgi, V. K. (Harvard Univ., Cambridge, Mass.). J. Phys., D (London); 3: 1100-6(Jul 1970).

The charge distribution in the boundary layer of an electron-emitting probe is studied in the continuum limit. It is found that for electron-to-ion density ratio of 10^{-1}, or less, the perturbation in the space-charge field is relatively small. In that case the charge distribution in the sheath can be investigated from the ion-collection probe data. This model is applied to analyze the tungsten probe data, for temperatures less than about 2215 K in 1-atm argon plasma, of 100- to 125-A arcs. The estimated charge density in the boundary layer of an electron-emitting probe compares favorably with the charge density obtained from a water-cooled, nonemitting probe. (auth) (UK)

35399 USE OF ION PROBES IN SUPERSONIC PLASMA FLOW. Scharfman, W. E.; Taylor, W. C. (Stanford Research

Inst., Menlo Park, Calif.). AIAA (Amer. Inst. Aeronaut. Astronaut.) J.; 8: 1067-72(Jun 1970).

Results using electrostatic probes biased to collect saturated ion currents are discussed. The probes were used to determine the freestream charge density and the ionization rise time in the supersonic flows generated by an arc-heated, pressure-driven shock tube. Freestream charge density was measured in the plasma produced by a magnetically driven shock tube. The charge density varied from 10^{10} to 10^{15} electrons/cm^3 and the initial shock tube pressure varied from 0.02 to 1 torr. The measurements of ionization rise time agree with other results at Mach numbers where comparison is possible. A region of Mach numbers not previously covered was also studied so that complete data on the ionization rise time as a function of Mach number for air now exists for Mach numbers from M = 8 to ≈26. The value of freestream charge density is inferred from the measured ion currents to cylindrical wires and wedge-shaped electrodes using a theory described. The agreement between the inferred charge density and the values obtained from microwave interferometers and equilibrium calculations are within a factor of 2. At pressures for which shocks form around the cylindrical wires, making probe interpretation difficult, a new type of probe—a small half-angle wedge—was calibrated. It is shown that a simple theory can account for the measured results. A more refined theory is required if this probe is to be used without calibration. (auth)

35400 THEORY OF A SPHERICAL ELECTROSTATIC PROBE IN A CONTINUUM GAS: AN EXACT SOLUTION. Baum, Eric; Chapkis, Robert L. (TRW Systems Group, Redondo Beach, Calif.). Contract DAHC 60-69-C-0008. AIAA (Amer. Inst. Aeronaut. Astronaut.) J.; 8: 1073-7(Jun 1970).

The idealized problem of a spherical electrostatic probe in a quiescent continuum slightly ionized chemically frozen gas of uniform properties is treated. Exact solutions are obtained for the probe characteristic for the case of equal ion and electron temperatures over a wide range of probe potential and ratio of probe radius to Debye length. The results are compared with available approximate numerical solutions. (auth)

35401 THIN-WIRE LANGMUIR-PROBE MEASUREMENTS IN THE TRANSITION AND FREE-MOLECULAR FLOW REGIMES. Dunn, Michael G.; Lordi, John A. (Cornell Aeronautical Lab. Inc., Buffalo). Contract NAS 5-9978. AIAA (Amer. Inst. Aeronaut. Astronaut.) J.; 8: 1077-81(Jun 1970).

Thin-wire Langmuir probes aligned with the flow direction have been used to measure the electron temperature and electron density in the inviscid nozzle flow of a short-duration reflected-shock tunnel. The electron density was inferred from the ion current portion of the probe characteristic and was simultaneously measured using microwave interferometers. The test gas used in these experiments was nitrogen at an equilibrium reservoir condition of 7200°K and 17.1 atm. At selected nozzle locations, the probe diameter and fineness ratio (L/D) of the probe were systematically varied in order to investigate probe performance in the transition and free-molecular flow regimes. The measured electron temperatures did not depend upon the probe diameter or the fineness ratio. The electron density inferred from the probe characteristic was found to be sensitive to collisional effects but insensitive to the fineness ratio in both the transition and free-molecular flow regimes. For free-molecular flow, the results agree with Laframboise's theoretical predictions for ion collection in a portion of the orbital-motion-limited region. For probes having a radius less than a Debye length in a free-molecular flow, the experimental results appear to disagree with the theory, the collected currents being larger than those predicted. In the transition-flow regime the correction for collisional effects given by Talbot and Chou provides good agreement between the Langmuir-probe and microwave-interferometer electron-density data. (auth)

Kinetics (General)

35402 (AD-702761) DESIGN OF A PLASMA CAVITY RESONATOR. Final Technical Report (Part IV). Roll, J. M.; Fagen, W. F.; Schneider, R. T. (Florida Univ., Gainesville. Dept. of Nuclear Engineering Sciences). 1 Jan 1970. Contract Nonr-580(19). 54p. CFSTI.

The design considerations of a cavity resonator to be used for coupling energy to a gas are discussed. The calculation of cavity dimensions is demonstrated. The resonator is studied theoretically in some detail. The measurement system employed is thoroughly explained. The experimental results are presented and shown to conform to theoretical expectations. The further experimentation proposed is outlined. (auth) (USGRDR)

35403 (IAE-1795) GAS DISCHARGE. Smirnov, B. M. (Akademiya Nauk SSR, Moscow. Institut Atomnoi Energii). 1969. 72p. (In Russian). Dep. CFSTI (U. S. Sales Only).

Three types of self-supporting discharge are studied. At low discharge currents, the space charge of the electrons and ions does not affect the properties of the discharge since there occurs potential removal of electrons by ions from the surface of the cathode. This type of discharge is called a Townsend or dark discharge. A discharge that corresponds to higher current densities is called a glow discharge. In a glow discharge, the formation of electrons at the cathode surface is also determined by the potential removal of them by ions, but in this case the space charge of the electrons and ions considerably affects the discharge properties. As the discharge current density increases, a glow discharge transforms into an electric arc. In an electric arc the formation of electrons at the cathode surface is due to thermoelectron and autoelectron emission. (JPRS)

35404 ABSORBENCY AND EMISSIVITY OF XENON PLASMA IN PULSED DISCHARGES. Gavrilova, L. I.; Doinikov, A. S.; Ignat'ev, V. G. Zh. Prikl. Spektrosk.; 12: 537-9(Mar 1970). (In Russian).

The temperature T and the absorbency index k_λ, which determine the optical properties of a plasma and allow its emissivity to be calculated, were investigated, measuring the various parameters of the plasma as a function of current density and pressure of the xenon gas that formed the plasma. Pressures of 100, 200, 300, 400, and 500 torr were used, determining the absorbency on the basis of the specific radiation reflected by a plane mirror and expressed by its translucence. It was found that, within the range studied, the absorbency is nearly directly proportional to the current density. The results also indicated that for a given current density, within the limits of experimental error, the temperature does not depend on the pressure. The absorbency was found to increase with the pressure up to 400 torr, remaining unchanged upon further increase of the pressure to 600 torr. Differences with respect to earlier data may be due to changes in the concentration of the neutral particles during the discharge. (TTT)

35405 EFFECT OF MASS INJECTION ON A HIGH-CURRENT ARC. Burton, Rodney L.; Devillers, Pierre; Chang, Orson (Univ. of California, San Diego, La Jolla). Contract DA-31-124-ARO-D-257. AIAA (Amer. Inst. Aeronaut. Astronaut.) J.; 8: 1111-16(Jun 1970).

To understand better the MPD arc and other accelerating high-current arcs, experimental and theoretical investigations are presented for a parallel-plate quasi-steady arc with argon or helium injection from a linear slit at the midplane. The arc is quasi-steady for about 350 μsec, and the quasi-steady current is 4 to 14 kA. Mass flow rate is set and controlled by an electromagnetically driven gas valve. It is found that at low mass flow rate the arc inductance oscillates, but that at a sufficiently high mass flow rate m_c, the arc voltage becomes constant. Measurements of m_c in argon and helium show a dependence $m_c \sim I^2/u_c$, where $u_c = (2eV_i/m)^{1/2}$ is the critical speed corresponding to the ionization potential. In addition, arc voltage is found to increase linearly with current. A simplified theoretical model is developed, based on one-dimensional constant area flow of a monofluid. Two physical constraints must be imposed to determine the downstream flow conditions, and these are 1) sonic downstream flow, and 2) m adjusts to minimize arc power input. These constraints predict $m \sim I^2/u_c$, and an electrical impedance $Z \sim u_c$. Both of these results show reasonable agreement with experiment. Application of the theory of high-current arcs with no mass injection indicates that the electrodes erode at a rate proportional to I^2. (auth)

Kinetics (Experimental)

Refer also to abstract 35375.

35406 (AD-704009) PLASMA INSTABILITIES AND COMPENSATION OF THE SPACE CHARGE OF AN ION BEAM. Nezlin, M. V. Translated from Dokl. Akad. Nauk SSSR; No. 277, 1-43(1966). 40p. (FTD-HT-23-208-69). CFSTI.

Intense ion beams in magnetic fields, employed in such as isotope separation and injection into plasma mirror machines are investigated experimentally to determine the beam intensity levels at which beam instabilities arise. A review of the work in this field is given. Detailed analysis of the most important processes include the discussion of the generation of plasma oscillations in a cold plasma interpenetrated by fast ion beams, the instabilities in the ion source plasma and amplification of oscillation in a cold plasma by ion beam oscillations. The criteria for instability growth, amplification, and interaction coupling are discussed and examples quoted. The proposed methods of improved compensa-

tion of the space charge of the ion beam are based on the conclusion that three-step instability behavior is basic to the system considered by the author. These include reduction in the oscillation amplitude in the ion source, reduction of the coefficient of growth of instability in the ion beam by redesigning the beam optics, and finally, the reduction of secondary plasma oscillations. (auth) (USGRDR)

35407 ELECTRICAL CONDUCTION IN ALKALI-METAL SEEDED CO_2. East, R. R.; George, D. W.; Messerle, H. K. (Univ. of Sydney). Plasma Phys.; 11: 889-93(Oct 1969).

Some experimental results are reported for electrical conduction in atmospheric-pressure CO_2 at temperatures up to 1500°C with pure metallic seeding of potassium and cesium. (UK)

35408 BROADENING OF HYDROGEN SPECTRAL LINES DURING TURBULENT HEATING OF A PLASMA. Antonov, A. S.; Zinov'ev, O. A.; Rusanov, V. D.; Titov, A. V. Zh. Eksp. Teor. Fiz.; 58: 1567-70(May 1970). (In Russian).

An attempt of noncontact determination of the degree of turbulency of a plasma is made on basis of Stark broadening of the hydrogen H_δ and H_γ spectral lines. The magnitude of the turbulence defined as the ratio of turbulent oscillation energy to plasma diamagnetism is $\sim 1.6 \times 10^{-3}$. (auth)

35409 PHOTOGRAPHIC OBSERVATIONS OF THE RETROGRADE ROTATION OF AN ARC DISCHARGE. Murphree, David L.; Carter, Richard P. (Mississippi State Univ., State College). Phys. Fluids; 13: 1747-50(Jul 1970).

Observations were obtained through high-speed photography on the dynamics of the magnetically induced retrograde rotation of a low-pressure argon arc discharge. Two distinctly different cases of retrograde motion were observed. In one case, the cathode spots form an apparently continuous cathodic arc region; in the second case, groups of discrete cathode spots exist. The behavior of the positive column for the two cases is dissimilar. The mode of retrograde rotation that occurs is determined by the applied magnetic field strength. (auth)

35410 BASIC LOSS PROCESSES IN THERMALLY IONIZED MAGNETOPLASMAS. PART II. EXPERIMENTS. Hashmi, M.; Van Der Houven Van Oordt, A. J.; Wegrowe, J.-G. (Institut fuer Plasmaphysik GmbH, Garching, Ger.). Nucl. Fusion; 10: 173-8(Jun 1970).

Particle losses much larger than given by the equilibrium theory have always been observed in the low-density range of thermally ionized magnetoplasmas in a Q device. This could be attributed either to anomalous radial losses or to enhanced end-plate recombination. The author's previous experiments with Ba in "narrow-beam illumination" and quiescent state have indicated an enhanced surface recombination rather than anomalous diffusion to be responsible for the additional losses. A series of results with Cs, Ba, Sr, and Li plasmas is presented and compared with the theory of Part I, which deals with enhanced surface recombination. It is found that the intrinsic loss processes are surface recombination, as described in Part I, and classical diffusion. Additionally, enhanced losses across the magnetic field may occur, e.g., in a nonquiescent state, or in the presence of azimuthal temperature gradients on the end plates in broad-beam illumination. (auth)

35411 EXPERIMENTAL STUDY OF STARK BROADENING OF NEUTRAL HELIUM LINE 5876 A IN A PLASMA. Puric, J.; Labat, J.; Cirkovic, Lj.; Konjevic, N. (Inst. of Physics, Belgrade). Fizika (Zagreb); 2: 67-72(1970).

Broadening of the 5876-Å line of neutral helium in the shock wave plasma in helium–hydrogen gas mixture was studied. The electron density of the plasma was found from the broadening of $H\delta$ line, while the temperature was determined from the relative intensities of neutral helium lines. Temperatures were in the range 3700 to 4900°K, and electron densities varied from 2.4 to $3.5 \cdot 10^{16}$ cm^{-3}. The Fabry–Perot axicon technique was used to determine the profile of the He I 5876-Å line. The broadening of this line was found to increase linearly with electron concentration and agrees within 5% with the theory. (auth)

35412 AN EXPERIMENTAL INVESTIGATION OF THE ELECTRODELESS TRAVELING-WAVE ACCELERATOR FOR WIND-TUNNEL APPLICATION. Seemann, G. R. (McDonnell Douglas Astronautics Co., Santa Monica, Calif.).; Thornton, J. A.; Penfold, A. S. Contract AF33(612)-2548. AIAA (Amer. Inst. Aeronaut. Astronaut.) J.; 8: 1104-11(Jun 1970).

An experimental investigation conducted to examine some of the physical processes that determine the density range over which traveling wave accelerators can be operated effectively is described. The experiments were conducted with two constant-field-velocity, constant-channel-diameter accelerators, using argon as the principal test gas. One accelerator was operated primarily subsonically, while the second accelerator was operated supersonically. Power inputs with the subsonic accelerator were in the range 50 to 100 kW with exit velocities of about 1000 m/sec. Gas densities were in the range 9×10^{-6} kg/m^3 to 8×10^{-4} kg/m^3. The experiments indicate that the energy exchange within the accelerator channel was controlled to a significant extent by Coulomb collisions and that the electron-energy distribution may have been non-Maxwellian. Power inputs with the supersonic accelerator were in the range 250 W to 2.5 kW. Exit velocities were in the range 2000 to 2700 m/sec with Mach numbers in the range of 1.5 to 2.2. Gas densities ranged from 10^{-4} to 5×10^{-4} kg/m^3. Although evidence of considerable end-field Joule heating was observed, the experiments were in general agreement with one-dimensional fluid-dynamic theory and indicate promise for the application of traveling-wave accelerators to wind tunnels in the altitude range to 150,000 to 300,000 ft. (auth)

Kinetics (Theoretical)

Refer also to abstract 35245.

35413 (MATT-758) THERMAL DIFFUSION IN A HIGHLY-IONIZED PLASMA COLUMN. Stefanov, B. (Princeton Univ., N. J. Plasma Physics Lab.). Apr 1970. Contract AT(30-1)-1238. 21p. Dep. CFSTI.

The flow of heat along a highly ionized plasma column is analyzed theoretically. The diffusion of a locally applied temperature disturbance is shown to be accompanied by a potential disturbance of approximately the same phase. Calculations of the phase lag of the temperature wave are presented and compared with measurements in a highly ionized cesium plasma column. The measured thermal diffusivity agrees with theory within 20%. (auth)

35414 (SC-RR-70-314) A ONE-DIMENSIONAL ELECTROSTATIC PIC CODE. Poukey, J. W. (Sandia Labs., Albuquerque, N. Mex.). Jun 1970. 32p. Dep. CFSTI.

A one-dimensional PIC code, suitable for certain problems involving electron beams and/or plasmas, was developed. The code follows a large number of charged particles as they move self consistently in their own electric field. These particles are located between two infinite plates with a fixed distance and potential difference between them. The code is described and its limitations discussed. Results are presented of applying the code to several problems, notably a space-charge flow and a beam–plasma problem. (auth)

35415 PLASMA AND ELECTRON BEAM. pp 176-93 of Microwaves. /Baden Fuller, A. J. New York; Pergamon Press, Inc. (1969).

The following sections are included: (1) properties of plasma, (2) electromagnetic properties, (3) plane wave in unmagnetized plasma, (4) magnetically biased plasma, (5) tensor permittivity, (6) plane wave in magnetized plasma, (7) rotation, (8) electron beam dynamics, and (9) beam current waves. (M.O.W.)

35416 THEORY OF EXCITATION AND IONIZATION OF ATOMS AND IONS IN NONTHERMAL EQUILIBRIUM. I. POPULATION OF EXCITED LEVELS. Suckewer, Szymon (Inst. of Nuclear Research, Swierk, Poland). Nukleonika; 14: 893-932 (Oct 1969).

Formulas defining populations of levels of excited atoms and ions in nonthermal equilibrium for a wide range of electron densities are presented. Analysis was made for frequently used cross sections for the excitation by electron impact. The influence of the differences between the cross sections on the calculated population densities of excited levels was determined. The paper also presents populations of excited levels calculated on the basis of the obtained formulae for hydrogen, hydrogenlike ions, and ions CII, CIII, CIV, NV and OVI. (auth)

35417 THEORY OF EXCITATION AND IONIZATION OF ATOMS AND IONS IN NONTHERMAL EQUILIBRIUM. PART II, IONIZATION EQUILIBRIUM, MEASUREMENTS OF ELECTRON DENSITY AND TEMPERATURE. Suckewer, Szymon (Inst. of Nuclear Research, Swierk, Poland). Nukleonika; 14: 1069-96 (Oct 1969).

Formulas are derived for the degree of ionization of atoms and ions in nonthermal equilibrium. The results obtained yield Saha's formula in the limit of relatively high electron densities. In conjunction with the partition function for nonthermal equilibrium, a general formula was obtained which gives both the degree of population of excited levels and the degree of ionization of atoms and ions within a wide range of electron densities. Analysis was made of the frequently used ionization cross sections by electron impact and photo-recombination. The influence of dif-

ferences between cross sections on the calculated ionization degrees of atoms and ions was determined. The paper includes results of calculations of the ionization degree of hydrogen atoms, hydrogenlike ions, and ions CII as a function of the electron density and temperature carried out on the basis of the theory of the ionization equilibrium. The paper also deals with the application of the formulas defining population densities of excited levels and the ionization equilibrium for electron density and temperature measurements. Diagrams are included which enable one to determine the electron temperature and density from relative intensities of 3 lines of a given ion. These methods are illustrated by electron temperature and density calculations for concrete experimental systems. (auth)

35418 SHOCK-WAVE FORMATION DURING INTERACTION BETWEEN MOVING PULSED PLASMA AND STATIONARY GAS-DISCHARGE PLASMA. Chutov, Yu. I. (Kiev State Univ.). Ukr. Fiz. Zh.; 15: 682-5(Apr 1970). (In Russian).

Previously, it was shown that perturbation of the luminescent intensity spreads in front of the pulsed plasma propagating in a stationary gas discharge. An attempt is made here of confirming the postulation assuming that such a perturbation was caused by a shock wave propagating in the gas discharge plasma. The graphs or rate of propagation of the perturbation as a function of the energy of the gas discharge current are analyzed for hydrogen and argon plasmas. (R.V.J.)

35419 TRANSPORT PROPERTIES OF HELIUM–POTASSIUM MIXTURES WITH DEPARTURES FROM EQUILIBRIUM. Darrigo, R. (Faculte des Sciences, Rouen, France. Institut National Superieur de Chimie Industrielle, Rouen, France). High Temp. - High Pressures; 1: 589-96(1969). (In French).

The transport properties of a helium–1% potassium mixture in the temperature range 1000 to 5000°K are evaluated by taking into account ten types of binary interactions between the four species: He, K, K^+, and e, assumed to be present. The departures from equilibrium are described by the ratio of electron temperature to gas temperature which varies between 1 and 5. Finally, expressions for the energy and mass transfer fluxes are discussed. (auth) (UK)

35420 HIGHER APPROXIMATIONS TO THE ION DISTRIBUTION FUNCTION AND VISCOSITY TENSOR FOR A FULLY IONISED COLLISIONAL PLASMA. Kolacek, Karel (Inst. of Plasma Physics, Prague). Plasma Phys.; 11: 929-43(Nov 1969).

The Boltzmann–Vlasov kinetic equation with the Landau collision term is solved for a fully ionized collisional plasma with a small β in a homogeneous magnetic and electrostatic electric field by the Mikhailovskii-modified Enskog–Chapman method. In this manner the ion distribution function is obtained, as well as the viscosity tensor from the definition. It turns out that this tensor can contain terms with derivatives of the heat-flow vector of the same order as the original terms; in a third approximation, moreover, "quadratic" terms proportional to the product of the pressure gradient and the temperature gradient, or to two temperature gradients, appear. The higher approximations are computed neglecting the effect of the inhomogeneities in the direction of the magnetic field. (auth) (UK)

35421 JUMP CONDITIONS FOR A TWO-FLUID MAGNETOPLASMA. Woods, L. C. (Balliol Coll., Oxford). Plasma Phys.; 11: 967-72(Dec 1969).

In a recent note (Sen and Spero, 1967) it was concluded that no hydromagnetic shock can exist in a two-fluid model unless the magnetic field is parallel to the shock front. This conclusion was based on an integrated form of Ohm's law across the shock, from which it was deduced that the magnetic induction B has to be continuous in all components across the front, unless its normal component was zero. The argument overlooks the very large normal electrical fields produced in shock fronts, fields that have been both calculated and measured experimentally (Paul et al., 1966; Robson and Sheffield, 1968). Ohm's law cannot be expressed in divergence form. It is shown in the present paper that in certain cases the energy equation for the ions can be expressed in divergence form and a simple relation deduced for the potential jump across a magneto-plasma shock wave. This relation is compared with some experimental results obtained for transverse shocks. (auth) (UK)

35422 PARTICLE DIFFUSION ALONG THE DIRECTION OF AN ELECTRIC FIELD ACTING TRANSVERSE TO A NONUNIFORM MAGNETIC FIELD. Puri, S. (Institut fuer Plasmaphysik, Garching, Ger.). Phys. Lett.; 32A: 55-6(15 Jun 1970).

A uniform electric field transverse to a spatially nonuniform magnetic field produces particle diffusion even when the electric field spectrum contains no dc component. This diffusion is additional to the usual E × B diffusion and occurs isotropically in the plane perpendicular to the magnetic field direction. (auth)

35423 THEORY OF NONLINEAR INTERACTION BETWEEN A LOW-DENSITY RELATIVISTIC ELECTRON BEAM AND PLASMA. Kovtun, R. I.; Rukhadze, A. A. (Lebedev Inst. of Physics, Moscow). Zh. Eksp. Teor. Fiz.; 58: 1709-14(May 1970). (In Russian).

Propagation of a stationary finite-amplitude wave in an unrestricted plasma being traversed by a low-density relativistic electron beam is investigated. The dispersion equation connecting the frequency with the wave vector and amplitude of wave field potential is derived. For infinitesimal amplitudes, the equation goes over to the dispersion equation of the linear theory and contains the familiar beam instability. The wave amplitude in this case grows with time. At sufficiently high amplitudes, when capture of beam electrons by the wave becomes possible, the beam instability becomes stabilized and the dispersion equation possesses only those solutions that correspond to stationary nonlinear field oscillations. This permits one to assess the electrostatic field that arises in the plasma during development of beam instability. (auth)

35424 BOUNDARY LAYERS IN ARGON PLASMA FLOWS. Valentin, Pierre; Piar, Georges; Terrier, Marc; Vervisch, Pierre (Rouen Univ., Mont-Saint-Aignan, France). Compt. Rend., Ser. A; 270: 1194-7(4 May 1970). (In French).

The distributions of the electron temperature and density in the boundary layer along a cooled metal wall put in an argon plasma flow are calculated. The electron density is very high near the wall. The thermal equilibrium of the electrons and the heavy particles is studied. (France)

35425 OHMIC RESISTANCE OF AN INHOMOGENEOUS PLASMA. Breizman, B. N.; Mirnov, V. V.; Ryutov, D. D. (Inst. of Nuclear Physics, Novosibirsk, USSR). Zh. Eksp. Teor. Fiz.; 58: 1770-83(May 1970). (In Russian).

The flow of a current through an inhomogeneous plasma is considered under conditions when the electron mean free path considerably exceeds the characteristic inhomogeneity dimensions. It is shown that the presence of a large number of captured electrons leads to a strong increase of the ohmic resistance compared to the case of a homogeneous plasma. The effective conductivity is calculated by simultaneously taking into account electron–electron and electron–hole collisions. The spatial distribution of the electric field applied to the plasma is found. (auth)

35426 PERPENDICULARLY PROPAGATING PLASMA CYCLOTRON INSTABILITIES SIMULATED WITH A ONE-DIMENSIONAL COMPUTER MODEL. Byers, Jack A.; Grewal, Mahesh (Univ. of California, Livermore). Phys. Fluids; 13: 1819-30 (Jul 1970).

Perpendicular propagating ($k_\parallel = 0$) cyclotron instabilities of velocity distributions $f(v_\perp) = \delta(v_\perp - v_\phi)/2\pi v_\perp$ and similar loss cone distributions with velocity spreads are simulated with a one-dimensional computer model. Essentially noise-free starting conditions are created by loading phase space in a uniform way. Growth starting from machine roundoff levels can be observed at precisely the linear Vlasov theory predictions, up to the saturated level, many orders of magnitude above the starting point. When the growth is dominated by a single wavenumber, the post-saturation time behavior of the electric field is dominated by recurring peaks separated by the cyclotron period. This causes the major frequency components of the nonlinear signal to be at or near harmonics of the cyclotron frequency rather than the linear real frequency, which is nonharmonic. The amplitude of succeeding bursts decays slowly, suggesting the existence of quasi-stable nonlinear states. A nonlinear instability was also observed. Furthermore, another $k_\parallel = 0$ instability, a double hump mode arising from the combination of a stable loss cone plus a small amount of cold ions, was examined. (auth)

35427 PROPAGATION OF HIGH CURRENT RELATIVISTIC ELECTRON BEAMS. Hammer, D. A.; Rostoker, N. (Cornell Univ., Ithaca, N. Y.). Phys. Fluids; 13: 1831-50(Jul 1970).

Theoretical self-consistent relativistic electron beam models are developed which allow the propagation of relativistic electron fluxes in excess of the Alfvén–Lawson critical-current limit for a fully neutralized beam. Development of a simple, fully relativistic, self-consistent equilibrium is described which can carry arbitrarily large currents at or near complete electrostatic neutralization. A discussion of a model for magnetic neutralization is presented wherein it is shown that large numbers of electrons from a background plasma are counterstreaming slowly within the beam so that the net current density in the system, and therefore, the magnetic field, is nearly zero. A solution of an initial-value problem for a beam–plasma system is given which indicates that

magnetic neutralization can be expected to occur for plasma densities that are large compared with beam densities. It is found that the application of a strong axial magnetic field to a uniform beam allows propagation regardless of the magnitude of the beam current. Some comparisons are made with recent experimental data. (auth)

35428 WELL-POSEDNESS CRITERIA FOR ONE-DIMENSIONAL UNSTEADY FLOW OF AN ANISOTROPIC PLASMA. Lynn, Y. M. (Univ. of Maryland, Baltimore). Phys. Fluids; 13: 1762-5(Jul 1970).

The local well-posedness criteria are: $2 + \beta \geq \beta_{\parallel} \geq \zeta - (\zeta^2 - \frac{1}{2}\beta^2 \tan^2\theta)^{\frac{1}{2}}$, where $\zeta = (1 + \beta)\sec^2\theta - \frac{1}{2}\beta$, β and $\beta_{\parallel}$ denote ratios of perpendicular and parallel pressures, respectively, to the magnetic pressure, and θ is the angle from the direction of spatial variation to that of magnetic field. They should be satisfied at each instant and in every transverse plane throughout any stable one-dimensional unsteady flow of an anisotropic plasma. (auth)

35429 TEST ION ENERGY LOSS IN A PLASMA WITH A MAGNETIC FIELD. May, Robert M.; Cramer, N. F. (Univ. of Sydney). Phys. Fluids; 13: 1766-70(Jul 1970).

The energy loss by a test ion in a plasma in the presence of a homogeneous magnetic field is considered, and numerical results for the magnetic field corrections to the rate of energy loss are presented. This is done for strong fields and for weak fields (i.e., for the electron cyclotron frequency greater than, and less than, the plasma frequency), and for all values of x, the ratio between test ion speed and plasma electron thermal speed; previous work is confined to $x \gg 1$. (auth)

35430 INSTABILITIES IN FINITE BEAM–PLASMA SYSTEMS. Evans, Kenneth Jr.; Jackson, E. Atlee (Univ. of Illinois, Urbana). Phys. Fluids; 13: 1885-8(Jul 1970).

The relationship between the temporal growth of linear fluctuations in a finite beam–plasma system, and the spatial growth of the resulting stationary oscillations is discussed. (auth)

35431 RADIAL STRUCTURE OF THE COLLISION-DOMINATED PLASMA COLUMN. Martisovits, V. (Komensky-Univ., Bratislava). J. Phys., B (London); 3: 850-9(Jun 1970).

The ambipolar diffusion problem is solved when charged-particle inertia and heating of positive ions, together with the ion mobility variation in the radial electrostatic field, are taken into consideration. For both constant mean free time and constant mean free path situations approximate formulae are found for the vairation of drift velocity of ions and radial potential close to the wall when the collisionless sheath is assumed. It is shown that the plasma column can be subdivided into three regions in the radial direction: the region of ambipolar diffusion, the transition region where the ion inertia predominates and the collisionless sheath at the wall. The influence of this structure on the mass-spectrometric sampling technique of a positive column is also noted. (auth) (UK)

35432 ENERGY DISPERSION OF POSITIVE IONS EFFUSED FROM AN RF PLASMA. Okamoto, Yukio; Tamagawa, Hajime (Nagoya Univ., Japan). J. Phys. Soc. Jap.; 29: 187-91(Jul 1970).

An ion extraction model for a plasma-sheath system for an rf plasma and its equivalent circuit are presented. A qualitative explanation of the energy anomalies is discussed. The energy dispersion of the ions under the assumption that the ion velocity is modulated by a time variation of plasma potential is calculated; this is in good agreement with experiments. (auth)

35433 CALCULATION OF THE FIELD OF A REFERENCE PARTICLE AS A FUNCTION OF THE NONLINEAR CHARACTERISTICS OF AN ANISOTROPIC PLASMA. Andreewsky, Alexandre (CEN, Fontenay-aux-Roses, France). Compt. Rend., Ser. B; 270: 1023-5(20 Apr 1970). (In French).

The nonlinear response of an anisotropic plasma slightly turbulent to the action of a reference particle is investigated. For this, the standard plasma model (Vlasov's equation) is used and, by a method of perturbation, the electric field of the reference particle is calculated as a function of the nonlinear conductivity of the plasma. (France)

35434 OPTICAL CONSTANTS OF FULLY IONIZED HYDROGEN PLASMA FOR LASER RADIATION. Hora, H.; Wilhelm, Hannelore (Institut fuer Plasmaphysik, Garching, Ger.). Nucl. Fusion; 10: 111-16(Jun 1970).

The refractive index n and the absorption constant K are numerically evaluated for fully ionized hydrogen plasmas as functions of the electron temperature T and atomic density N for the case of ruby, neodymium-glass, and CO_2 laser radiation and for the second harmonics of each type of radiation on the basis of the two-fluid model of hydrodynamics using Spitzer's collision frequency. Limitations due to degeneration, too small Debye length, and nonlinear effects are given. The absorption constant is compared with the values of the quantum theory of inverse bremsstrahlung without collective effects, and with the Dawson–Oberman theory. (auth)

35435 FLUID DYNAMICAL EQUATIONS FOR THE COLLISIONLESS PLASMA IN THE PRESENCE OF A STRONG MAGNETIC FIELD. Kusukawa, Ken-ichi; Kobayashi, Yoshio; Takahashi, Tsuguo (Tokyo Metropolitan Univ.). J. Phys. Soc. Jap.; 29: 199-204(Jul 1970).

The electron plasma frequency of a plasma depends on the number density, while the Larmor frequency is proportional to the magnetic field. The applied magnetic field is supposed to be so strong that the Larmor frequency is sufficiently larger than the collision frequency. When the considered plasma is very dilute, the plasms frequency is small compared with the Larmor frequency. In such situations, starting from the Vlasov equation, and using a similar expansion procedure to the method due to Chew, Goldberger and Low, the macroscopic equations governing the plasma in the fluid-dynamic stage are obtained in the form of two fluid model. Using these equations, the propagation of plane waves is studied and the dispersion relation for a wave propagating in an arbitrary direction is obtained. It is shown that there exist six wave modes. (auth)

35436 BASIC LOSS PROCESSES IN THERMALLY IONIZED MAGNETOPLASMAS. PART I. THEORY. Hashmi, M.; Van Der Houven Van Oordt, A. J.; Wegrowe, J.-G. (Institut fuer Plasmaphysik, Garching, Ger.). Nucl. Fusion; 10: 163-72(Jun 1970).

A theoretical explanation for the experimentally observed enhanced surface recombination of the ions in a thermally ionized magnetoplasma in a Q device is proposed. It is based on a collisionless treatment that yields a non-Maxwellian velocity distribution for the plasma particles. The influence of rate collisions on the velocity distribution, particularly in double-ended operation (D.E., both end plates hot), is discussed, and it is shown that even in the case of a partially thermalized plasma with a thermalization rate of about 50%, the surface recombination causes still a $J_0 \sim n$ dependence instead of a $J_0 \sim n^2$ dependence as found in the case of a fully thermalized plasma. (auth)

35437 ANOMALOUS RESISTANCE OF PLASMAS IN SUBCRITICAL ELECTRIC FIELDS. Sizonenko, V. L.; Stepanov, K. N. (Physico-Technical Inst, Kharkov). Nucl. Fusion; 10: 155-62(Jun 1970).

On the basis of the theory of weak turbulence, it is shown that the principal mechanism limiting the development of ion–acoustic instability in a current-carrying plasma in an electric field can be the nonlinear scattering of oscillations by electrons. The energy density of turbulent ion–acoustic pulsations is of the order $W \sim (2m_e/m_i)n_0T_e$, where n_0 is the plasma density, T_e the electron temperature, and $m_{e,i}$ the electron and ion mass. Electron scattering by turbulent pulsations occurs with an effective frequency $\nu_t \sim (2m_e/m_i)\omega_{pe}$ and leads to an anomalous effective plasma conductivity $\sigma = \omega_{pe}^2/4\pi\nu_t$, where ω_{pe} is the electron Langmuir frequency. Ion–acoustic instability develops a plasma in weak electric fields ($E < E_{cr} = (m_e/e)v_{th}\nu_s$) when the current velocity is less than the thermal velocity of the electrons, $v_{th} = \sqrt{T_e/m_e}$. The critical field E_{cr} in a high-temperature dilute plasma is much stronger than the Dreicer field $E_D = (m_e/e)v_{th}\nu_c$, where ν_c is the electron–ion collision frequency. The estimates of σ and ν_s are in good agreement with conductivity measurements made in a number of turbulent plasma heating experiments. (auth)

35438 SLOW-NEUTRON-SCATTERING CROSS SECTIONS FOR A MAGNETICALLY CONFINED PLASMA WITH ELECTROSTATIC ION OSCILLATIONS. Weil, J. W. (Univ., Innsbruck). Nucl. Fusion; 10: 193-5(Jun 1970).

Results from Sunakawa's [Sunakawa. S., et al., Progr. Theor. Phys. 37: 6(1967)1051] work is applied to the scattering of slow neutrons by the heavy ions of cesium plasma, which is confined by a homogeneous magnetic field in the x direction and, in addition, exhibits electrostatic ion oscillations in the x direction. Dissipative effects such as Landau damping were neglected. (M.O.W.)

35439 SYNCHROTRON RADIATION FROM A PLASMA SLAB. Canobbio, E.; Giufre, S. (CEN de Saclay, Gif-sur-Yvette, France). Nucl. Fusion; 10: 189-93(Jun 1970).

An extension is made of existing calculations on synchrotron radiation from a thermonuclear plasma to electron temperatures as high as 200 keV. An extensive tabulation of the transparency factor and other relevant quantities is presented. (M.O.W.)

35440 EFFECT OF ELECTRON COLLISIONS ON CHERENKOV RADIATION FROM MAGNETOPLASMA. Dhukla, P. K.; Singh, R. P.; Singh, R. N. (Banaras Hindu Univ., India). Int. J. Electron.; 28: 421-5(May 1970).

The theory of Cherenkov radiation from magnetoplasma was modified to account for the effect of electron collision frequency. The results are compared with the Cherenkov theory for collisionless magnetoplasma. The Cherenkov radiation in the magnetosphere is unaffected by electron collisions. In the ionosphere the radiated power is found to change by several times as compared to radiation by collisionless magnetoplasma. (auth) (UK)

Production

35441 ENERGY BALANCE OF AN ARC DISCHARGE IN HYDROGEN GAS. Verboom, G. K. (FOM-Instituut voor Plasma-Fysica, Rijnhuizen, Netherlands). Plasma Phys.; 11: 903-16(Nov 1969).

Presented are numerical calculations of the temperature and the pressure profiles and the voltage–current characteristic of a cylindrical arc column with an applied axial magnetic field. A radial pressure gradient is established by means of ambipolar diffusion of charged particles across the magnetic field and by means of the Nernst–Ettinghausen effect. Radiation losses are neglected. The dissociation of hydrogen molecules is taken into account, which has a great influence on the temperature profile and on the dissipated power if the axial temperature is not too high (<$10^{3.5}$°K). Neglecting dissociation, as is often done, can lead to serious errors. The effect of the magnetic field on the dissipated power and the temperature profile is discussed. (auth) (UK)

35442 BALANCE OF NEGATIVE IONS IN A PLASMA SOURCE OF GREAT INTENSITY. Gabovich, M. D.; Naida, A. P.; Isaev, F. M. (Inst. of Physics, Kiev). Ukr. Fiz. Zh.; 15: 667-71 (Apr 1970). (In Russian).

Experimental data are obtained on the plasma parameters of a reflective discharge that is a source of hydrogen negative ions. The balance of the negative ions in such a plasma was considered, and an expression is obtained for the dependence of negative ion current on discharge current. The results of this calculation are in good agreement with the experimental data. Comparison of the experimental and calculated data also enables one to evaluate the cross section for the decay process of negative ions by electrons, the value of which proves to be in good agreement with the data of B. M. Smirnov and M. N. Chibisov. (auth)

35443 INTERACTION OF SHORT LASER PULSES WITH SOLID MATERIALS. Caruso, A.; Gratton, R. (EURATOM-CNEN, Franscati, Italy). Plasma Phys.; 11: 839-47(Oct 1969).

The plasma production from a solid by means of an energetic (≈10 J) short light pulse ($\tau \approx 10^{-11}$ sec) is studied theoretically. It is found that the irradiation of a massive target results in the production of a hot spot with a lifetime comparable to the equipartition time of the energy between electrons and ions. The conditions for an efficient heating of small pellets are given. Some reasons for the absorption of the light in a collisionless regime are considered. (auth) (UK)

35444 EXPERIMENTAL INVESTIGATION OF THE PRODUCTION AND CONTAINMENT OF A LASER-PRODUCED PLASMA. Bruneteau, J.; Fabre, E.; Lamain, H.; Vasseur, P. (Ecole Polytechnique, Paris). Phys. Fluids; 13: 1795-1801 (Jul 1970).

The results of optical interferometric measurements in a laser-produced plasma are presented. Two processes are studied. First, the quantity of charge in the plasma, as a function of the power density at the focal spot; agreement is found with the theoretical one-dimensional heating model. Second, expansion in a uniform magnetic field. Here, confinement occurs in the first stage and is rapidly perturbed by a large flow of the plasma across the field. This flow is explained by a charge separation when a highly directed velocity exists. (auth)

35445 METHOD AND DEVICE OF PRODUCTION OF NON-CONTAMINATED PLASMOIDS. Consoli, Terenzio; Slama, Lucien (to Commissariat a l'Energie Atomique). British Patent 1,195,602. 17 Jun 1970. Priority date 2 Feb 1967, France.

A method is described for producing a burst of non-polluted plasma which comprises providing a target at a second focal point of an ellipsoidal system in a closed chamber. The target becomes a plasma under intense heat and electromagnetic radiation from an explosive discharge placed at a first focal point. Several variations of the technique are described. (M.O.W.)

Stability

Refer also to abstract 35372.

35446 (COO-1695-27) PLASMA INSTABILITIES AND WAVES EXCITED BY AN ANISOTROPIC ENERGY DISTRIBUTION PRODUCED BY ELECTRON CYCLOTRON RESONANCE. Quarterly Progress Report No. 13. Shohet, J. L.; Sprott, J. C.; Seshadri, S. R. (Wisconsin Univ., Madison. Dept. of Electrical Engineering). 15 Jun 1970. Contract AT(11-1)-1695. 44p. Dep. CFSTI.

Computer simulation of electron cyclotron heating and of rf confinement was extended. The effect of varying the plasma density, and hence the importance of space charge electric fields, was studied. Calculations of the free–free bremsstrahlung from an anisotropic, relativistic plasma were continued. The validity of the various approximations used in the derivation were studied, and corrections made for the finite mass of the nucleus. Calculations of the polarization of the bremsstrahlung were carried out, and this promises to be a useful tool for determining plasma anisotropy. The experimental program was enhanced by improving the reproducibility of the plasma by reducing the ripple on the magnetic field and magnetron high-voltage supply by an order of magnitude and by the construction of a 50-watt cw microwave source. Measurements of the heating efficiency were made in order to compare with previous theoretical predictions. Flute instabilities were observed and studied. The cw microwave source was used to produce plasmas and to study off-resonance heating. Upper off-resonance heating is relatively inefficient, and lower off-resonance heating drives the plasma out of the machine by a process not yet understood. The electromagnetic instability previously observed was studied further to determine the scaling of frequency with heating frequency and mirror ratio. Comparisons are being made with other similar experiments and with theoretical predictions. (auth)

35447 DRIFT INSTABILITIES IN AFTERGLOW PLASMAS. Pigache, D. R.; Harding, G. N. (Culham Lab., Abingdon, Eng.). Plasma Phys.; 11: 805-9(Oct 1969).

Low-frequency drift instabilities were identified in helium afterglow plasma in a longitudinal magnetic field. The condition for stability at magnetic fields <1000 G is that the product of the ion cyclotron frequency and the ion–neutral collision time should be less than unity. (auth) (UK)

35448 LOW-FREQUENCY INSTABILITY IN INHOMOGENEOUS PLASMA FORMED BY HOLLOW ION BEAM. Gabovich, M. D.; Protsenko, I. M.; Tovmachenko, V. N.; Kolochko, V. N. (Inst. of Physics, Kiev). Ukr. Fiz. Zh.; 15: 648-53(Apr 1970). (In Russian).

Experimental results are cited of low-frequency instability plasma formed by a hollow ion beam traveling along a magnetic field. This plasma has a peculiarity. It has outer and inner boundaries with opposite directions of radial density gradients with invariable directions of the radial electric field, which arises due to incomplete compensation of ion beam space charge. In this plasma, low-frequency ($\omega \ll \omega_{ci}$) oscillations are detected with maximum of the amplitude localized in the region of positive and negative radial density gradients. The data obtained agree with the theory of inhomogeneous plasma stability in the presence of crossed electric and magnetic fields. (auth)

35449 PLASMA STABILIZATION BY FEEDBACK. Taylor, J. B.; Lashmore-Davies, C. N. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). Phys. Rev. Lett.; 24: 1340-2(15 Jun 1970).

A simple model is discussed that illustrates the general features of plasma stabilization by an external feedback system. This indicates that different phase relations in the feedback loop are needed to stabilize differing classes of electrostatic instability. (auth)

35450 CORRELATION OF ELECTRICAL POWER AND OPTICAL OSCILLATIONS IN LOW-DENSITY HELIUM PLASMA. Gavril, S.; Schieber, D. (Israel Inst. of Tech., Haifa). Electron. Lett.; 6: 286-7(30 Apr 1970).

The correlation of electrical power and optical oscillations in low-density helium plasma is presented, and results are analyzed. (auth) (UK)

35451 RELATIVISTIC CYCLOTRON INSTABILITIES. Blanken, R. A. (Princeton Univ., N. J. Massachusetts Inst. of Tech., Cambridge); Stix, T. H.; Kuckes, A. F. Plasma Phys.; 11: 945-60(Nov 1969).

A velocity space instability was observed in plasmas produced by electron cyclotron resonance heating, which causes greatly enhanced diffusion into the mirror loss cones. The instability occurs at frequencies slightly above the second harmonic of the

nonrelativistic cyclotron frequency and is observed only if a relativistic runaway component is present in a dense, finite-temperature background plasma. The line shape predicted by the frequency-dependent growth rate is in good agreement with the observed emission spectrum. The convective nature of the instability predicted by the theory is examined experimentally. Limitation of the wave growth at large wave amplitudes is also discussed. (auth) (UK)

35452 DYNAMIC STABILIZATION OF DRIFT WAVES BY ELECTRON TEMPERATURE MODULATION. Dobrowolny, M.; Engelmann, F.; Levine, A. M. (EURATOM-CNEN, Rome). Plasma Phys.; 11: 973-82(Dec 1969).

The effect of a small, periodic, time-dependent modulation of the electron temperature on the linear stability of a weakly inhomogeneous magnetoplasma is considered. Such a modulation may be produced by microwave heating of electrons. It is found that the collisionless instabilities may be stabilized when the heating of an unstable drift wave with the temperature modulation is subject to an additional damping mechanism (e.g., ion Landau damping). No stabilizing effect has been found for the resistive drift mode described by a fluid approximation. (auth) (UK)

35453 COLLISIONLESS DRIFT INSTABILITIES IN A BOUNDED PLASMA. Bertotti, B.; Nocentini, A. (EURATOM-CNEN, Rome). Plasma Phys.; 12: 39-53(Jan 1970).

Effects of emitting plates orthogonal to the magnetic field on the drift modes in the collisionless regime are studied. The relationship between the current and electric field is, in this case, a nonlocal one, thus producing a situation much more complicated than in the collisional problem. The local dispersion relation is evaluated with an expansion in Fourier series along the magnetic field; the contribution from the trapped particles is identical to the infinite case, but the free particles provide a coupling between the different modes. In the case of a longitudinal phase velocity lying between the electron and the ion thermal velocities, the drift modes are substantially changed only in two cases. If the transit time of the fastest trapped particles is a multiple of half the period, there are resonant oscillations of the two sheaths facing the electrodes; there is also a new dispersion relation for modes with a longitudinal wave length $\lambda_{||}$ much larger than the length L of the machine. For the other modes it is shown that if the instability condition of the infinite case is satisfied for $\lambda_{||} < 2L$, so is the bounded problem. (auth) (UK)

35454 EFFECT OF AN ELECTRON CURRENT ALONG THE MAGNETIC FIELD ON THE DEVELOPMENT OF IONIZATION INSTABILITY IN A LOW-TEMPERATURE PLASMA. Zampaglione, V. (CNEN, Rome). Plasma Phys.; 12: 23-30(Jan 1970).

In deriving the dispersion equation of ionization waves in a (low-temperature) seeded MHD plasma, allowance is made for an electron current along the impressed magnetic field. This leads to a critical value of the Hall parameter, which depends on the angle (α) between current and magnetic field by a factor $1/\sin\alpha$. Furthermore, the most unstable waves no longer travel at right angle relative to the magnetic field direction; their increment and direction are given in terms of α and magnetic field strength. (auth) (UK)

35455 DYNAMIC STABILIZATION OF COLLISION-DOMINATED DRIFT WAVES IN PRESENCE OF AN ac CURRENT. Dobrowolny, M.; Engelmann, F.; Levine, A. M. (EURATOM-CNEN, Rome). Plasma Phys.; 11: 983-5(Dec 1969).

A criterion is derived for the stabilization of drift waves in a collision-dominated plasma by an ac parallel to the magnetic field. (auth) (UK)

35456 ANOMALOUS HIGH-FREQUENCY RESISTIVITY AND HEATING OF A PLASMA. Kruer, W. L.; Kaw, P. K.; Dawson, J. M.; Oberman, C. (Princeton Univ., N. J.). Phys. Rev. Lett.; 24: 987-90(4 May 1970).

Computer experiments were carried out on the anomalous heating of a one-dimensional plasma by a large-amplitude long-wavelength electric field oscillating near the plasma frequency. Above a certain threshold, the large driver field excites an instability in the plasma and drives up ion-density fluctuations as well as plasma oscillations. When the ion fluctuations reach a sufficiently large level, the plasma begins to heat very efficiently according to an anomalous resistivity. An effective collision frequency as high as $0.2\omega_{pe}$ was observed. A theoretical explanation of the observed results is given. (auth)

35457 ROTATIONALLY CONVECTED DRIFT-WAVE INSTABILITY IN AN INHOMOGENEOUS PLASMA COLUMN. Aldridge, R. V.; Keen, B. E. (Culham Lab., Abingdon, Eng.). Plasma Phys.; 12: 1-16(Jan 1970).

Measurements are reported on self-excited oscillations in a rotating inhomogeneous plasma column. This rotation is associated with an azimuthal drift arising from the existence of a radial electric field and a longitudinal magnetic field. The observed oscillation frequency appears to be related to the rotational frequency of the plasma. The methods of measurement of both the instability and the rotational frequency are discussed. A theory is developed based on the two-fluid equations in slab geometry, in which an electric field parallel to the direction of the density variation and perpendicular to a magnetic field is considered. Collisions of the ions with neutrals are also taken into account. The predictions from this theory are then compared with the experimental observations. In view of the limitations implicit in the theory relatively good agreement with the measurements is obtained. (auth) (UK)

35458 SUPPRESSION OF DRIFT-WAVE INSTABILITY BY rf ELECTRIC FIELD. Nishida, Y.; Tanibayashi, M.; Ishii, K. (Nagoya Univ., Japan). Phys. Rev. Lett.; 24: 1001-3(4 May 1970).

The suppression of drift instability is observed by applying a homogeneous rf electric field in a dc-discharge diffused plasma The instability amplitude is reduced by more than a factor of 30 and, concomitantly, a decrease of plasma loss across the magnetic field is also observed. (auth)

35459 EVOLUTION FROM LINEAR TO NONLINEAR SATURATION OF INSTABILITIES AND CHANGE IN ZEROTH-ORDER CONDITIONS. Sato, Masumi (Yamagata Univ., Yonezawa, Japan). Phys. Rev. Lett.; 24: 998-1000(4 May 1970).

An evolution from the linear growth to the nonlinear saturated state of instability is investigated by observing the spatially growing ionization waves (moving striations) in a plasma. The behavior of the instability is shown to obey the Landau amplitude equation. Partial, gradual change in zeroth-order conditions by the nonlinear effect is also found. (auth)

35460 SIMULATION OF COUNTERSTREAMING PLASMAS WITH APPLICATION TO COLLISIONLESS ELECTROSTATIC SHOCKS. McKee, Christopher F. (Univ. of California, Livermore). Phys. Rev. Lett.; 24: 990-4(4 May 1970).

A one-dimensional sheet-charge model is used to simulate homogeneous counterstreaming plasmas with no magnetic field. It is demonstrated that the only electrostatic instability capable of dissipating a substantial fraction of the relative ion-drift energy and thus generating a turbulent, collisionless shock is the ion–ion two-stream instability. Furthermore, it is shown that such a shock cannot occur at high Mach numbers. (auth)

35461 MAGNETOHYDRODYNAMIC STABILITY OF A DIFFUSE SCREW PINCH. Freidberg, J. P. (Los Alamos Scientific Lab., N. Mex.). Phys. Fluids; 13: 1812-18(Jul 1970).

The magnetohydrodynamic stability of a diffuse screw pinch is investigated in an attempt to explain certain discrepancies between experiment and sharp boundary theory. It is found that the stability of a diffuse pinch is fairly sensitive to the B_θ profile and can lead to large differences from the sharp boundary model. By suitably adjusting B_θ in the diffuse profile, the original discrepancy between experiment and theory is removed. (auth)

35462 CONVECTIVE CELLS IN A QUIESCENT PLASMA REGION. Harries, W. L. (Princeton Univ., N. J.). Phys. Fluids; 13: 1751-61(Jul 1970).

Periodic spatial variations of density and potential were observed in the quiescent region of a plasma, in the magnetohydrodynamically stable region of a linear multipole. The variations were of the order of 50%, and were both radial and along the axial direction z, along which the magnetic field configuration was approximately invariant. Measurements of E/B velocities, as well as of particle flux, revealed drift velocities in closed vortices or convective cells, with the drift kinetic energy as high as 30% of the electron thermal energy. The cells persisted in the afterglow for at least a millisecond, roughly the plasma containment time. The axial dimension of the cells depended on the spatial variation of the input power density during ionization and heating; radially they extended from the stagnation point to near ψ_c [where $\partial(\oint dl/B)/\partial\psi = 0$], where there were large fluctuations of density and potential with time. The density in the quiescent region decayed at about the same rate as the density in the region of temporal fluctuations. The effect of convective cells on plasma loss is discussed. (auth)

35463 FLUTE-LIKE INSTABILITIES IN PLASMA WITH CYLINDRICAL RELATIVISTIC ELECTRON BEAM. Striffler, C. D.; Kammash, T. (Univ. of Michigan, Ann Arbor). Phys. Fluids; 13: 1851-5(Jul 1970).

The linearized, relativistic Vlasov equations are analyzed for the stability of flute-like modes in an infinite, collisionless plasma

with a cold background and a relativistic annular electron beam situated in a uniform external magnetic field. Neglecting self-fields, a dispersion equation is obtained for small thickness beams. It is found that oscillations with frequency near harmonics of the gyrofrequency of the relativistic electrons are unstable. The most unstable oscillations are shown to be those with long wavelengths relative to the thickness of the beam. Growth rates and conditions for instability are given for systems where the beam particles are charge neutralized by cold background ions, and when the beam particles are dilute compared with the background species. For rarefied beams, an instability occurs at the hybrid frequency of the background species where the growth rate depends on the beam thickness. As the background density increases, a critical value can be reached where the long-wavelength oscillations are stabilized; and short-wavelength oscillations become most unstable. For these modes growth rates are maximized with respect to the harmonic number $\frac{1}{2}$, and beam velocity $\beta = v/c$. (auth)

35464 INITIAL COMPARISON OF TRANSFORM AND PARTICLE-IN-CELL METHODS OF COLLISIONLESS PLASMA SIMULATION. Armstrong, T. P.; Nielson, C. W. (Los Alamos Scientific Lab., N. Mex.). Phys. Fluids; 13: 1880-1(Jul 1970).

Two fundamentally different methods are used to simulate the nonlinear development of a strong two-stream instability. Transform and particle-in-cell simulations are shown to agree for the rate and limiting amplitude. (auth)

35465 NOTE ON INSTABILITIES OF COLLISIONLESS PLASMA DUE TO A SHEAR MAGNETIC FIELD. Mittal, M. L. (Indian Inst. of Tech., Bombay). Plasma Phys.; 11: 1024-7 (Dec 1969).

The present analysis aims to study the nature of the instabilities of the neutral sheet in the tail of the magnetosphere, which is very important for the understanding of the auroral zones and other terrestrial phenomena. (UK)

35466 INSTABILITY OF THE LINEARLY POLARIZED MODE IN COUNTERSTREAMING ELECTRON-ION PLASMAS. Lee, Kai Fong (Catholic Univ. of America, Washington, D. C.). J. Appl. Phys.; 41: 3045-7(Jun 1970).

The instability of the linearly polarized mode propagating perpendicular to the magnetic field, considered previously for counterstreaming electron plasmas, is here studied for plasmas with ion streaming using the cold-plasma equations. For two ion beams with velocities $+u_i$ and $-u_i$ in a neutralizing background of electrons, it is found that instability occurs when $u_i > c\Omega_i/\omega_{pi}$, with maximum growth rate $(u_i^2\omega_{pi}^2/c^2 - \Omega_i^2)^{\frac{1}{2}}$, when Ω_i and ω_{pi} are, respectively, the ion cyclotron and plasma frequencies; c is the velocity of light. The case of two counterstreaming plasmas with both electron and ion streaming is also discussed. (auth)

35467 RAYLEIGH-TAYLOR INSTABILITY OF A ROTATING PLASMA. Ariel, P. D. (Malaviya Regional Engineering Coll., Jaipur, India). Nucl. Fusion; 10: 141-4(Jun 1970).

The effect of finiteness of the ion-Larmor radius on the Rayleigh-Taylor instability of a rotating plasma of variable density is studied. A semi-finite plasma in which density is assumed to be stratified one-dimensionally in a direction transverse to that of the static uniform magnetic field is considered. The inclusion of the finite-Larmor-radius effect is found to have a stabilizing influence on the unstable configuration. (auth)

35468 STRONG STABILIZING EFFECT IN ANISOTROPIC, COLLISIONLESS, UNMAGNETIZED PLASMAS. Schaffer, M. J. (Univ. Tecnica del Estado, Santiago de Chile). Nucl. Fusion; 10: 123-30(Jun 1970).

Very-fast-compression, hot-ion, high-β theta pinches are sometimes hydrodynamically stable, in spite of slight unfavorable field-line curvature. This phenomenon cannot be explained quantitatively by conventional finite-ion-Larmor-radius theory since the orbits are larger than the diameters of the plasmas considered. Therefore, an idealized, collisionless "bounce" model (elastic ion reflections from a negligibly thin sheath) with the magnetic field totally excluded from the bulk of the plasma is assumed for analysis. The ion trajectories are then calculated for slowly growing flute perturbations of the interface. It is found that ions having angles of incidence near $0, \pi/m, \ldots, (\frac{1}{2}m-1)\pi/m$ for even mode numbers m, or near $\pi/2m, 3\pi/2m, \ldots, (m-1)\pi/2m$ for odd m become trapped and reflected only from the flute indentations. Therefore, a strong restoring force results if the initial velocity distribution contains a sufficient density of ions at one of these critical angles. In particular, radially concentrated distributions are always stabilizing for m = 2. Moderately concentrated distributions are also stabilizing for m = 3, but this mode is unstable for stronger radial concentration. (auth)

35469 STABILITY THEORY OF PLASMA CURRENT MULTIPOLE. Jukes, J. D. (Gulf General Atomic Inc., San Diego, Calif.). Nucl. Fusion; 10: 131-40(Jun 1970).

The plasma current multipole has a deep average well and strong shear due to a characteristic separatrix and stagnation point produced by moderately strong plasma currents and special shaping of the flux surfaces by a conducting wall to include, for example, quadrupole terms. The stability of a toroidal device with a large aspect ratio κ^{-1} and relatively strong toroidal field component B_0 is discussed with respect to helical modes localized about flux surfaces, driven by gradients in both pressure and current, and to axisymmetric modes. Stability considerations lead to a torus whose minor cross section is a particular configuration utilizing only one petal of the 'figure-of-eight', with its stagnation line on the side nearest the axis of symmetry and coplanar with the magnetic axis. This wall shape produces toroidal-volume effects and shear satisfying the necessary conditions for stability of localized modes at relatively large values of current density j_0 and pressure P_0 so that $(jK-S/j_0)^2 \sim \kappa$, $2P_0/B_0^2 \sim \kappa^{\frac{1}{2}}$, where j_{K-S} is the Kruskal-Shafranov current. Comparison is made with a standard Tokamak. (auth)

35470 LOW-BETA PLASMA EQUILIBRIUM AND STABILITY IN LINEAR FILAMENTARY MULTIPOLE MAGNETIC FIELDS. Tanaka, Masatoshi; Tamura, Sanae (Japan Atomic Energy Research Inst., Tokai). Jap. J. Appl. Phys.; 9: 526-31(May 1970).

Analytical results are presented for two stability integrals along a field line and for a class of low-β plasma equilibria in linear multipole magnetic fields. The integral $\oint dl$ calculated for quadrupole and hexapole fields, $\oint dl/B$ for quadrupole, hexapole, and octopole fields. They are expressed in terms of the complete elliptic integral of the first kind. The stability limit lines defined by $(\partial/\partial\psi) \oint dl = 0$ and $(\partial/\partial\psi) \oint dl/B = 0$ (ψ: flux function) are determined together with the magnetic mirror ratio on those field lines. The magnetic well depth is also estimated. Low-β plasma equilibria in multipole fields are obtained by the perturbation technique. Variations of the field lines due to the plasma diamagnetism are calculated up to the linear terms in plasma pressure. (auth)

35471 INSTABILITY IN A WEAKLY IONIZED AFTERGLOW PLASMA WITH A MAGNETIC FIELD IN A SHORT TUBE. Kando, Masashi; Uno, Takehiko; Minami, Kazuo; Takeda, Susumu (Nagoya Univ., Japan). J. Phys. Soc. Jap.; 29: 192-8(Jul 1970).

In a very short discharge tube, the oscillation with a frequency of a few kHz appears in the afterglow with a relatively weak magnetic field. The frequency of the observed oscillation is much lower than the ion cyclotron frequency. The critical magnetic field B_c, when the instability sets up, is proportional to the pressure P and B_c/P becomes smaller in the shorter tube. The diffusion deviates from the classical value, when the magnetic field exceeds B_c. The oscillation is theoretically analyzed to be due to an instability enhanced by the large axial density gradient. The theory is based on the two-fluid model, which takes the axial density gradient into account, neglecting the ion and electron inertia terms. The observed frequency, the relation between B_c and P or the tube length, and the relation between P and the oscillation amplitude can be explained by the present theory. (auth)

35472 WAVE MOTION IN A COLLISIONLESS PLASMA WITH ANISOTROPIC PRESSURE. Gupta, R. M.; Varma, N. L. (Univ. of Rajasthan, Jaipur, India). Ann. Soc. Sci. Brux. Ser. I; 84: No. 1, 47-54(25 May 1970).

The propagation of small-amplitude waves in a collisionless, infinite plasma was studied in the presence of constant external magnetic field with anisotropic pressure tensor. One-component plasma where ions were treated to provide a uniform positive charge background was considered. The general dispersion relation considering the wave vector having three compounds such as $k = k_x + k_y + k_z$ along the axes of the coordinate system was obtained, and propagation of waves along the magnetic field and perpendicular to it were studied. (auth)

Thermonuclear Processes

35473 (ORNL-TM-2564) KERMA FACTORS AND SECONDARY GAMMA-RAY SOURCES FOR SOME ELEMENTS OF INTEREST IN THERMONUCLEAR BLANKET ASSEMBLIES. Ritts, J. J.; Solomito, M.; Steiner, D. (Oak Ridge National Lab., Tenn.). 12 Jun 1970. Contract W-7405-eng-26. 53p. Dep. CFSTI.

Neutron and gamma-ray fluence to kerma factors were calculated for lithium-6, lithium-7, beryllium, carbon, fluorine, copper, and niobium. Secondary gamma-ray spectra were calculated for lithium-6, lithium-7, carbon, fluorine, and niobium. An attempt was made to include all significant reactions, i.e., elastic scattering with an anisotropic correction, inelastic scattering, neutron capture, (n,2n) reactions, (n,charged particle) reactions, and beta

or positron emissions from these reactions. The kerma factors and secondary gamma-ray spectra presented herein have proved extremely useful in the calculation of heating rates within thermonuclear blanket assemblies. (auth)

35474 DISPLACEMENT OF THE CURRENT DISTRIBUTION IN A HIGH-CURRENT TOROIDAL DISCHARGE. Robinson, D. C. (Culham Lab., Abingdon, Eng.). Plasma Phys.; 11: 893-7(Oct 1969).

The toroidal displacement of a diffuse pinch was studied in the Zeta device. The results are compared with the theory of Shafranov (1963) using field configurations generated by a model close to those observed experimentally. (UK)

35475 NONADIABATIC ORBITS IN A STUFFED CUSP FIELD. Rizk, H. M. (Atomic Energy Establishment, Cairo). Plasma Phys.; 11: 1021-4(Dec 1969).

The analysis of individual particle orbits makes it possible to judge the effectiveness of methods of confinement of plasma. Traps with stuffed cusp fields are still considered promising in thermonuclear investigations. In this note, the properties of the nonadiabatic orbits of particles and the associated loss rates in a stuffed cusp field are investigated. This investigation is a step toward understanding the behavior of a complete plasma in a stuffed cusp field. (UK)

35476 EFFECTS OF INTRODUCING SUPPORTS IN A LEVITATED TOROIDAL QUADRUPOLE. Stirling, W. L.; Roberts, M.; Alexeff, I. (Oak Ridge National Lab., Tenn.). Phys. Fluids; 13: 1888-9(Jul 1970).

The effect of introducing supports into a levitated toroidal quadrupole is determined. Using double probe techniques, no measurable effect on the probe flux, electron temperature, or plasma lifetime, for a support size less than 5-mil diam was found. (auth)

35477 NONEXISTENCE OF A CLASS OF MAGNETOHYDRODYNAMICAL TOROIDAL EQUILIBRIA. Tasso, H. (Institut fuer Plasmaphysik, Garching, Ger.). Phys. Fluids; 13: 1874-5(Jul 1970).

In the axisymmetric case, it is possible to prove the nonexistence of a class of magnetohydrodynamic toroidal equilibria. Resistivity is taken into account, but the motion is incompressible and purely meridional. (auth)

35478 SNAPSHOT OF FUSION POWER RESEARCH. Kilb, R. W. (General Electric Research and Development Center, Schenectady, N. Y.). pp 1.D.2.1-6 of Conference Record. Portland, Oreg.; Institute of Electrical and Electronics Engineers (1968).

From 6th IEEE Region Conference, Partland, Oreg. See CONF-680502.

An extensive research program is attempting to harness the fusion reactions of D–D and D–T for central power station use. The immediate problem is the extension of the magnetic containment of a hot, fully ionized plasma of D^+ and T^+. Several new experimental devices will test the relative efficiency of magnetic wells and magnetic shear for isolating the plasma from the vacuum container walls. The high-β Scyllac device at Los Alamos and the low-β Floating Multipole device at Princeton are described. Competitive requirements vis-à-vis fossil and fission power plants indicate that power costs of 4 mills/kw-hr and capital costs of $100/kw (in today's dollar) will have to be met. Major cost factors in hypothetical fusion reactors appear to be the tritium breeding blanket and the superconducting magnetic field coils. The economics of the research and development program are commented upon. (auth)

35479 MODIFIED TORSATRON-TYPE SYSTEMS. Loktionov, Yu. M.; Sebko, V. P. (Physico-Technical Inst., Kharkov). Nucl. Fusion; 10: 179-84(Jun 1970).

Magnetic field configurations for containment of a high-temperature plasma are proposed. These Vintotors systems represent a kind of "synthesis" of two familiar systems, the Torsatron and the Vintotron. The results of analyses of Vintotors configurations are compared with Vintotron systems. It is shown that the proposed plasma trap possesses a number of advantages over the previous type. With a magnetic well depth of 5 to 7% a shear value of 0.15 to 0.28 is obtained in the Vintotors system. (auth)

35480 NEW METHODS OF DRIVING PLASMA CURRENT IN FUSION DEVICES. Ohkawa, T. (Gulf General Atomic Inc., San Diego, Calif.). Nucl. Fusion; 10: 185-8(Jun 1970).

New methods of driving current in resistive plasmas are proposed. Ion beams of high and low energy are injected in a plasma. Plasma electrons and ions receive momenta through Coulomb interaction from the respective beams. The resultant forces compensate the loss of relative momenta between electrons and ions due to plasma resistivity. When used in a toroidal plasma device, the methods eliminate the necessity of inductive electric fields, thus making it possible for the device to operate in a steady state. The required power for the methods may be made much smaller than the fusion output power. (auth)

35481 PLASMA ACCELERATION IN A CONICAL INDUCTION SOURCE. Churaev, V. A.; Khizhnyak, N. A.; Kravchin, B. V. This paper was summarized in At. Energ. (USSR); 27: 144-5(Aug 1969) as paper No. 332/5053-5055. (In Russian).

The acceleration of a plasmoid in a conical induction source is considered. An investigation of the system of equations given by [V. A. Churaev et al., Zh. Tekh. Fiz. 38: 395 (1968)] showed that there exists two classes of solutions determining the conditions of operation of an induction source. They are determined by the quantity ωt_0 ($2\pi/\omega$ is the period of the discharge of the capacitor battery of the source and t_0 is the time at which the plasmoid is formed), and by the magnitude of the magnetic field trapped by the plasmoid. (auth)

35482 HOT NEW PROMISE OF THERMONUCLEAR POWER. Alexander, Tom. Fortune; 81: No. 1, 94-7; 126; 130; 132(Jun 1970).

A brief historical discussion of the progress of controlled thermonuclear research is given. The devices that now have the capability for confining plasma longer than the Bohm time are briefly described. The advantages of a thermonuclear power plant as opposed to conventional power plants are discussed. Some of these include direct conversion of electricity, steam heating, and waste disposal. (M.O.W.)

Wave Phenomena

Refer also to abstracts 35372, 35392, and 35466.

35483 (AEC-tr-7146) PLASMA PHYSICS AND THE PROBLEMS OF CONTROLLED THERMONUCLEAR SYNTHESIS. HIGH-FREQUENCY PROPERTIES OF PLASMA. ISSUE NO. 3. Tolok, V. T. (ed.). Translation of Fizika Plazmy i Problemy Upravlyaemogo Termoyadernogo Sinteza. Vysokochastotnye Svoistva Plazmy. Vypusk 3, Naukova Dumka, Kiev, 1968. 227p. Dep. CFSTI.

Twenty-two papers are presented on the hf properties of plasma, microwave methods in plasma diagnostics, and MHD and shock waves. An abstract from the original Russian appeared previously in NSA 23: 32359. (M.O.W.)

35484 (SU-IPR-357) STUDIES OF PLASMA OSCILLATIONS. Status Report No. 35, August 1, 1969–January 31, 1970. Crawford, F. W. (Stanford Univ., Calif. Inst. for Plasma Research). Feb 1970. Contract AT(04-3)-799. 54p. Dep. CFSTI.

Results of experimental and theoretical research are presented on each of the following: (1) low-frequency wave propagation and positive column instabilities, (2) electron cyclotron echoes and collision measurements, (3) wave–wave interaction phenomena, and (4) beam–plasma interactions. (M.O.W.)

35485 (SU-IPR-362) LAGRANGIAN DERIVATION OF NONLINEAR WAVE COUPLING COEFFICIENTS. Galloway, J. J. (Stanford Univ., Calif. Inst. for Plasma Research). Apr 1970. Contract AT(04-3)-799. 37p. Dep. CFSTI.

A concise method is developed for obtaining the mode-coupling coefficient for weak nonlinear interaction of waves or oscillations. It applies to any continuous medium which can be described by a Lagrangian density, and is based on an extension, via Hamilton's principle, of the Manley–Rowe type relationships for such a system. The coupling coefficient is calculated by means of that part of the Lagrangian density that describes the lowest-order nonlinear behavior of the system, and the process uses as input the relationships between wave parameters obtained from the standard linear or small-signal theory. The approach is intended, through its simplicity and close connection with Lagrangian mechanics, to offer improved insight, and a saving in algebraic manipulation for complicated problems. (auth)

35486 EXPERIMENTAL OBSERVATION OF THE BALLISTIC PLASMA ELECTRON WAVE ECHO. Ripin, B. H.; Pechacek, R. E. (Univ. of Maryland, College Park). Phys. Rev. Lett.; 24: 1330-3(15 Jun 1970).

Plasma–electron-echo experiments are described in which the relation between the echo wavelength and frequency is given by $\omega_2/k_2 = v'$, where v' is a constant independent of the primary frequencies used to generate the echo. The velocity v' is approximately equal to the velocity at which the electron distribution has maximum slope. It is concluded that the relation between

echo frequency and wavelength is determined by the ballistic properties of the electrons. (auth)

35487 ANALYSIS OF THE NATURE AND GROWTH OF ELECTROTHERMAL WAVES. Nelson, A. H.; Haines, M. G. (Imperial Coll. of Science and Tech., London). Plasma Phys.; 11: 811-37(Oct 1969).

Using a linear theory, the dispersion relation of electrothermal waves in a seeded, partially ionized gas is derived. Two modes appear, one of which is always damped, while the other is unstable in certain plasma situations. This is the ionization instability, and the growth rate was calculated as a function of the steady-state electron temperature, the angle between the steady-state current density and the wave vector, the Hall parameter, and the instability wavelength. The dispersion relation differs from previous dispersion relations in that it is more complete, containing the effects of finite ionization–recombination rates, finite degree of ionization, radiation transfer, electron thermal conduction and the combination of both neutral and Coulomb collisions. Results show that, for fixed magnetic fields, the growth rate has a maximum as a function of electron temperature, falling off at low temperatures due to the effects of finite ionization–recombination rates, and at high temperatures due to the decreasing Hall parameter. However, if the Hall parameter is kept constant by increasing the magnetic field, the growth rate does not fall off much until much higher temperatures where the seed becomes nearly fully ionized. Finally, the possibility of stabilizing the waves using the damping effect of radiation transfer is discussed. (auth) (UK)

35488 PLASMA FLUCTUATIONS IN GULF GENERAL ATOMIC QUADRUPOLE DEVICE. Ohkawa, Tihiro; Yoshikawa, Masaji (Gulf General Atomic Inc., San Diego, Calif.). Plasma Phys.; 11: 795-803(Oct 1969).

The results of the fluctuation measurements in the Gulf General Atomic quadrupole are summarized. The characteristics of the fluctuations are compared with the theories for the drift instabilities with modulated magnetic fields. None of the measured properties of the fluctuations are in conflict with the theoretical predictions. (auth) (UK)

35489 ANOMALOUS DIFFUSION AND OSCILLATIONS IN AN AFTERGLOW PLASMA. Dodo, T. (Institut fuer Plasmaphysik, Garching, Ger.). Plasma Phys.; 11: 881-7(Oct 1969).

Diffusion and oscillations of a helium plasma are investigated in metal and glass chambers. The experiment is carried out in the range from 200 to 3000 G and from 0.02 to 0.1 torr. The plasma is produced by a pulsed electron beam and its diffusion coefficient across the magnetic field is obtained from the spread-out time of ions to a Langmuir probe inserted off the central axis. The diffusion and oscillations in the metal chamber are similar to those in the glass chamber. When $\omega_{ci}\tau_{in} < 1$, there are no oscillations in the plasma density and the diffusion is classical and ambipolar. When $\omega_{ci}\tau_{in} > 1$, oscillations in the plasma density and a fluctuating azimuthal electric field appear and the diffusion becomes of Bohm-type. (auth) (UK)

35490 KINETIC INTERACTION OF POSITIVE-ENERGY WAVES IN A PLASMA. Rebhan, E. (New York Univ., N. Y.); Wimmel, H. K. Plasma Phys.; 11: 869-79(Oct 1969).

Summational invariants, conservation theorems, equilibrium spectra, and the H theorem associated with the kinetic equation for wave–wave interaction in a plasma are presented in their mutual relationship. If in some reference frame all waves have positive energies then the system always goes to equilibrium. It follows from conservation theorems that the final equilibrium state depends on the initial conditions. Regular equilibria, with $N_K > 0$, may only occur as final states of time-varying solutions. For the "three-wave case," in which only separate wave triplets are coupled, the general solution of the initial-value problem is given, and it is shown that at sufficiently early times any time-dependent solution of the kinetic equation is either nonphysical (some $N_K < 0$) or degenerate (some $N_K = 0$). (auth) (UK)

35491 HELICON-WAVE PROPAGATION IN A LABORATORY PLASMA. Jolly, A. B.; Martelli, G.; Troughton, J. F. (Univ. of Sussex, Eng.). Plasma Phys.; 11: 863-7(Oct 1969).

Measurements have been made of the propagation of axially symmetric helicon waves in the afterglow of a pulsed plasma. The experimental values for the dispersion relation approach the theoretical values calculated for a cylindrical plasma column with zero-order Bessel function radial density distribution, after time intervals several times longer than the radial diffusion time. (auth) (UK)

35492 LANDAU POLES, BRANCH CUTS, AND SUPRA-LUMINOUS WAVES IN A ONE-DIMENSIONAL PLASMA. Lerche, I. (Univ. of Chicago). Plasma Phys.; 11: 849-61(Oct 1969).

A simple initial-value problem is set up for a one-dimensional, mobile, electron plasma coexisting with a positive charged, immobile background. The calculation is performed relativistically in order to correctly account for branch points and branch cuts of the dispersion functions. The computation is done to clarify work performed elsewhere, and as a prelude to the problem of generation rates of supra-luminous waves in a plasma ensemble, since some of the results obtained here will be used in such an analysis. (auth) (UK)

35493 TRANSFORMATION OF PLASMA WAVES IN A MAGNETOACTIVE PLASMA. Yip, W. K. (Univ. of Tasmania, Hobart, Australia). Planet. Space Sci.; 18: 479-94(Apr 1970).

Using the system of hydrodynamic equations, the coefficient for transformation of high-frequency weakly damped plasma waves in a magnetoactive plasma was obtained. The expressions obtained are studied numerically with parameters appropriate to the active solar corona. (auth) (UK)

35494 HELICON WAVES IN A GASEOUS PLASMA. Davies, B.; Christiansen, P. J. (Flinders Univ. of South Australia, Bedford Park). Plasma Phys.; 11: 987-1000(Dec 1969).

Results are given of a combined theoretical and experimental investigation of helicon propagation in a plasma. The theory is for a nonuniform, resistive, cylindrical plasma, and includes the effect of electron inertia. The experimental frequency range is $0.1\,\Omega_e \lesssim \omega \lesssim 0.5\,\Omega_e$, and the effect of the electron cyclotron resonance is clearly seen even at the lowest frequencies. Excellent agreement is obtained between theory and experiment. (auth) (UK)

35495 HELICON WAVES IN CYLINDRICAL PLASMA COLUMNS. Shoucri, M. M. (Faculte des Sciences, Orsay, France). Plasma Phys.; 11: 1017-19(Dec 1969).

The purpose of the present work is to extend the results previously obtained by Kitsenko and Shoucri (1968a), concerning the dispersion and excitation of helicon waves in a finite plasma of planar geometry, to the case of a cylindrical geometry. The m = 0 mode is considered (no azimuthal dependence). (auth) (UK)

35496 PLASMA WAVES IN GRAD'S THIRTEEN-MOMENT APPROXIMATION. Burman, R. (Univ. of Western Australia, Perth). Plasma Phys.; 11: 1019-20(Dec 1969).

Small-amplitude waves are considered in a plasma which is homogeneous, nonmagnetized, and stationary in the unperturbed state; ion motion is neglected. (UK)

35497 LINEAR TRANSFORMATION OF WAVES IN A MAGNETOACTIVE PLASMA GENERATED BY A STRONG MICROWAVE SIGNAL. Musil, J.; Zacek, F. (Inst. of Plasma Physics, Prague). Plasma Phys.; 12: 17-22(Jan 1970).

This paper describes the experimental verification of the linear transformation of the LHCP wave (left-hand circularly polarized) in a magnetoactive plasma, in which the electron density surpasses the critical value, i.e. $\omega_0^2/\omega^2 \simeq 1$; ω is the frequency of the wave generating the plasma, ω_0 is the plasma frequency. The study is carried out for magnetic fields satisfying the condition $\omega_{c_e}/\omega < 1$; ω_{c_e} is the electron cyclotron frequency. (auth) (UK)

35498 EXCITATION OF LONGITUDINAL WAVES BY CONVERSION OF TRANSVERSE WAVES. Fidone, I. (CEN, Fontenay-aux-Roses, France). Plasma Phys.; 12: 31-7(Jan 1970).

The problem of energy conversion of high-amplitude transverse waves into longitudinal ones is discussed for a magnetoactive plasma. The dynamics of three interacting waves is discussed, using the methods of nonlinear optics. The frequencies of the transverse wave are assumed very large, whereas the frequency of the longitudinal wave may be a frequency characteristic of the system. A general formula for the length of the total conversion is given in terms of the longitudinal electron permeability. Two examples of conversion are discussed in detail, i.e., excitation of Bernstein modes and of ion cyclotron waves. It is shown that for sufficiently large but attainable amplitudes of the transverse waves the length of conversion may be of practical interest. (auth) (UK)

35499 STUDY OF THE POTENTIAL SURFACE WAVES IN PLASMA IN THE PRESENCE OF AN EXTERNAL MAGNETIC FIELD. Abdel-Shahid, N. Z.; Pakhomov, V. I. (Atomic Energy Establishment, Cairo). Plasma Phys.; 12: 55-65(Jan 1970).

Propagation of slow ($v_p \ll c$) surface waves along the plane boundary of two plasmas, along the plane plasma layer, and along the plane vacuum layer in a plasma is investigated. The directions of the external magnetic field and the wave propagation are assumed to be arbitrary. Dispersion equations are derived and investigated. In some cases the frequencies of surface waves are obtained. The damping decrements resulting from the work done

by the surface wave field on the plasma are determined. (auth) (UK)

35500 RELATIVISTIC PLASMA DISPERSION RELATION. Lamborn, B. N. A. (Florida Atlantic Univ., Boca Raton). Plasma Phys.; 11: 899-902(Nov 1969).

The relativistic plasma dispersion relation for waves propagating perpendicular to a constant magnetic field is transformed into a rapidly converging series of integrals. Landau damping of the electrostatic waves is recovered in the limit of zero magnetic field. (auth) (UK)

35501 ACCELERATION OF CHARGED PARTICLES BY STOCHASTIC ELECTROSTATIC WAVES. Knorr, Georg (Univ. of Iowa, Iowa City). Plasma Phys.; 11: 917-28(Nov 1969).

The velocity change of charged particles in a one-dimensional electrostatic stochastic wave is investigated analytically. The reaction of the particle back on the wave is not taken into account. One model adopted is a wave, the phase of which is completely randomized after time intervals of length τ. The other model considers particles moving in fields of slowly changing amplitude so that their adiabatic invariant is conserved. Only untrapped particles are considered. In the frame where the wave is at rest, all particles are decelerated. In the laboratory frame, this corresponds to acceleration of particles which are slower and deceleration of particles which are faster than the phase velocity of the wave. In addition, a diffusion in velocity space is found. This may have an accelerating action in the laboratory frame. Expectation and variance of particle ensembles are derived and discussed for different asymptotic limits. (auth) (UK)

35502 ION-ACOUSTIC WAVES IN A PLASMA COLUMN, GENERATED BY MEANS OF ECR. Music, J.; Zacek, F.; Datlov, J.; Teichman, J. (Inst. of Plasma Physics, Prague). Plasma Phys.; 11: 961-4(Nov 1969).

One type of low-frequency oscillation measured in the plasma column generated by an electron cyclotron resonance device in a waveguide in a homogeneous magnetic field is shown to be an ion-acoustic wave because of variation of the frequency as a function of the measured temperature of electrons, the length of column, and the mass of ions. (auth) (UK)

35503 VELOCITY OF ION BURSTS IN A PLASMA. Joyce, G. (Institut fuer Plasmaphysik, Garching, Ger.). Plasma Phys.; 11: 964-6(Nov 1969).

A calculation is presented to demonstrate the frequency dependence of packets of free-streaming ions excited by a plane grid immersed in a plasma. (auth) (UK)

35504 SHIELDING OF LOW-FREQUENCY EM RADIATION BY A BOUNDED PLASMA IN A MAGNETIC FIELD. Troughton, J. F. (Univ. of Sussex, Brighton, Eng.). Plasma Phys.; 12: 67-70(Jan 1970).

The penetration of electromagnetic fields into a plasma slab with conducting boundaries when $\omega_p \ll \omega_p$, $\omega \ll \omega_c$ (ω being the oscillation frequency of the fields, ω_p the plasma frequency and ω_c the electron cyclotron frequency) is considered. Under these conditions, it is found that the shielding properties of the plasma depend strongly on the ratio of the electron Larmor radius to the thickness of the plasma slab as well as on the electron density in the plasma. (auth) (UK)

35505 ELECTROMAGNETIC WAVE ECHO IN A PLASMA. Kemoklidze, M. P.; Pitaevskii, L. P. (Inst. of Physical Problems, Moscow). Zh. Eksp. Teor. Fiz.; 58: 1853-6(May 1970). (In Russian).

An effect of the spatial plasma echo type for transverse electromagnetic waves in the absence of an external magnetic field is considered in the third order of perturbation theory. The wave frequency is assumed lower than the Langmuir plasma frequency and the effect leads to nonlinar penetration of the waves into the plasma. The amplitude increases with growth of the distance between the grids producing the field. (auth)

35506 DISPERSION RELATION FOR A PERIODIC PLASMA. Bertrand, Pierre; Felx, Marc.; Baumann, Germain (Nancy Univ.). Compt. Rend., Ser. B; 270: 1153-5(4 May 1970). (In French).

The propagation of a long-wavelength electromagnetic wave in a periodic plasma can be explained by considering that the plasma is made of very excited resonators connected to each others by zones of exponential attenuation. One can draw a dispersion curve by joining the points corresponding to the more excited modes that exist for every resonance frequency. (France)

35507 EXPERIMENTAL TEST OF A KINETIC THEORY OF TONKS-DATTNER RESONANCES. Ignat, D. W. (Yale Univ., New Haven). Phys. Fluids; 13: 1771-7(Jul 1970).

Experiments were performed to test the effectiveness of a recent kinetic theory of plasma wave resonances in a warm inhomogeneous plasma column. The calculation and measurements are compared qualitatively with regard to resonance wave forms and quantitatively with regard to resonance location. An approximate comparison is made with calculations based on velocity moments of the Vlasov equation. (auth)

35508 LINEAR AND NONLINEAR THEORY FOR WAVES IN A PLASMA COLUMN IN A STRONG MAGNETIC FIELD. Jensen, Torkil H. (Gulf General Atomic Inc., San Diego, Calif.). Phys. Fluids; 13: 1778-83(Jul 1970).

A linear theory is formulated for electrostatic waves in a plasma column in a strong magnetic field. It is assumed that the electron velocity distribution is independent of space, while the plasma density may be an arbitrary function of radius. This condition may be closely matched experimentally. The formalism is closely related to the usual theory of the infinite homogeneous plasma and, like that theory, it provides a prescription of how to find the electric potential that results from an externally applied space charge. Therefore, weak nonlinearities may be treated. As an example, the theory for the plasma wave echo, with the effects of velocity space diffusion included, is extended to the plasma column case. As another example of the use of the formalism, the effect of a weak electron beam added to the plasma column is also calculated. (auth)

35509 SURFACE WAVES ON A PLASMA HALF-SPACE. Kaw, P. K.; McBride, J. B. (Princeton Univ., N. J.). Phys. Fluids; 13: 1784-90(Jul 1970).

The effect of density gradients and a finite temperature on the dispersion relation for surface waves on a plasma half-space is investigated analytically. The full set of Maxwell's equations is used to obtain the dispersion of surface waves on a warm homogeneous plasma, thus complementing earlier work on the electrostatic mode. The full surface-wave dispersion relation is then derived for a cold plasma with arbitrary but weak density profile in the WKB limit. Finally, the dispersion of electrostatic surface modes on a cold plasma with a linear density profile of arbitrary strength is obtained. It is shown that when the density variation over a wavelength is very large, a new type of damped surface wave with a frequency higher than the surface plasma frequency is possible. (auth)

35510 ACOUSTIC AND PSEUDO-ACOUSTIC WAVE PROPAGATION IN A POSITIVE COLUMN. Gervais, C.; Glaude, V. M. (Montreal Univ.). Onde Elec.; 50: 325-9(Apr 1970). (In French).

In the study of the interaction of an acoustic wave mechanically produced in a nitrogen positive column, it is shown that one must take into account the production of pseudo-acoustic waves. These waves can only propagate in the anode-to-cathode direction owing to the drift velocity of the charged particles. Therefore, the phase velocity of the observed wave depends on the direction of the electric field. Finally, in the propagation of a pure acoustic wave it is found that the electron density variations and the electron-neutral collision frequency variations differ in amplitude. The theory is in fair agreement with the experiments previously done. (France)

35511 OPTICAL MIXING IN A MAGNETOACTIVE PLASMA. Weyl, Guy (Univ. of California, Los Angeles). Phys. Fluids; 13: 1802-11(Jul 1970).

The nonlinear interactions of two electromagnetic waves resulting in the excitation of electrostatic oscillations of a homogeneous plasma in a strong magnetic field are studied. Starting from the cold plasma equations for electrons, and neglecting ion motions, a general expression for the second-order density perturbation of the plasma in the presence of two first-order electromagnetic waves is derived. One basic assumption made is that the frequencies of the electromagnetic waves are much larger than the plasma frequency and than the electron cyclotron frequency. The second-order density perturbation is explicitly calculated in the two cases where the difference frequency and wave vector of the interacting waves satisfy the dispersion relation for plasma oscillations and for the upper hybrid resonance. The scattering cross section for electromagnetic radiation per electron due to the excited electrostatic oscillation is calculated and compared to cross section due to thermal fluctuations. The results are applied to a laboratory Q device using ruby lasers as sources of the electromagnetic waves and to an ionospheric plasma using radio waves. The effect of finite beamwidth and of nonuniform plasma density is also considered. It is found that the excited oscillations near either of the two resonances considered in the

ionosphere should easily be observed by use of a satellite receiving part of the scattered radiation. This method of excitation and detection is suggested for sounding of ionospheric plasmas. (auth)

35512 COUPLING OF ELECTROSTATIC WAVES IN A NON-GYROTROPIC PLASMA. Eldridge, Owen (Univ. of Tennessee, Knoxville, Oak Ridge National Lab., Tenn.). Phys. Fluids; 13: 1791-4(Jul 1970).

The dispersion relation for small-amplitude electrostatic waves in a nongyrotropic plasma is derived. The equilibrium distribution function is not symmetric in the plane perpendicular to the magnetic field and is necessarily periodic in time. A single electrostatic mode contains a linear superposition of potentials with the same wavelength and damping rate but with different frequencies separated by the cyclotron frequency. The dispersion relation is solved for the case of small asymmetry. The asymmetry then leads to a linear coupling of known modes, with small changes in known dispersion relations. (auth)

35513 ION ACOUSTIC WAVE PROPAGATION IN THE PRESENCE OF TRANSVERSE INHOMOGENEITY. Korn, P. (Cornell Univ., Ithaca, N. Y.). Phys. Fluids; 13: 1882-3(Jul 1970).

A criterion is developed that determines when the one-dimensional free-space dispersion relation is a valid description for longitudinal propagation along a bounded plasma in the presence of a large axial magnetic field. (auth)

35514 NUMERICAL STUDY OF COLLISIONAL EFFECTS ON SPATIAL ION-WAVE ECHOES. Nishikawa, Kyoji; Gould, Roy W. (California Inst. of Tech., Pasadena). Phys. Fluids; 13: 1883-5(Jul 1970).

Collisional effects on the second-order spatial ion-wave echo are studied numerically. General agreement is obtained with the experimental results of Ikezi, Takahashi, and Nishikawa. A critical argument is raised against the validity of the small collision approximation. (auth)

35515 INFLUENCE OF ELECTRON CONCENTRATION ON RESONANCE PHENOMENON DURING TRANSFORMATION OF UHF OSCILLATIONS IN MAGNETOACTIVE PLASMA. Shtykov, V. V. Izv. Vyssh. Ucheb. Zaved., Radioelektron.; 12: 1193-6 (1969). (In Russian).

A differential equation describing the behavior of the plasma magnetization vector is obtained, and a solution is found for the case of interactions of two harmonic oscillations with different frequencies. The variable mangetization with variable frequency is described by plasma and field parameters acting in the plasma. Experimental calculations of the emf in the coil as a function of the magnetic field are given. (tr-auth)

35516 NONLINEAR STABLE COLLISIONLESS DRIFT WAVES. Zhmudskii, A. A.; Lisitchenko, V. V.; Oraevskii, V. N. (Kiev State Univ.). Nucl. Fusion; 10: 151-3(Jun 1970).

Analytic expressions have been found for the profile of nonlinear stable drift waves in a collisionless anisothermal plasma, and also for the relationship of the wave velocity to the wave amplitude. It is shown that the nature of the nonlinear waves (compression or rarefaction) depends substantially on the type of electron distribution function. The wave amplitude is assumed to be small but finite. For the distribution function closest to the Maxwellian, the nature of the wave is determined by the parameter $\eta = d \ln T/d \ln n$. (auth)

35517 EXCITATION OF SURFACE WAVES ON PLASMAS. Anicin, B. A. (Boris Kidric Inst., Belgrade). Fizika (Zagreb); 2: 45-52(1970).

The launching efficiency, surface-wave amplitude, and radiation field on an infinite slot antenna above a dielectric/plasma interface are computed, using Cullen's method. The results are akin to those found with classical reactive structures: the radiation field near the guide can be minimized by the choice of slot height, wavelength and plasma frequency; launching efficiency has a very broad maximum with variation of plasma dielectric constant. (auth)

Shielding

Refer also to abstracts 34951, 34952, 35728, 35775, 36015, and 36077.

35518 (DASA-1892-5) WEAPONS RADIATION SHIELDING HANDBOOK. CHAPTER 2. BASIC CONCEPTS OF RADIATION SHIELDING ANALYSIS. Stevens, Paul N.; Claiborne, H. Clyde (Oak Ridge National Lab., Tenn.). Jun 1970. 80p. Dep. CFSTI.

The following topics are covered: quantities used to describe radiation fields, special radiation fields, quantities used to describe radiation interactions, radiations produced in nuclear weapons, interactions of neutrons, neutron production processes, interactions of gamma rays, gamma-ray production processes, quantities used to describe responses to radiation, and radiation exposure limits. (M.H.R.)

35519 (HASL-231) BROAD BEAM ^{137}Cs AND ^{60}Co γ TRANSMISSION THROUGH LAMINATED LEAD-CONCRETE BARRIERS. Beck, Harold L. (New York Operations Office (AEC), N. Y. Health and Safety Lab.). Jun 1970. 20p. Dep. CFSTI.

The transmission of normally incident broad beams of ^{137}Cs and ^{60}Co γ rays through various thicknesses of lead barriers followed by concrete barriers is calculated, using a half-range Legendre polynomial approximation to the Boltzman transport equation. The method reproduces well the available experimental results for simple barriers. The calculated laminated barrier transmission factors conveniently lead to more realistic shielding requirements for radiography and teletherapy facilities than combinations of transmission factors for simple barriers. The uncertainties in the calculated results are estimated to be less than ±5%. The reverse calculation, for a concrete barrier followed by a lead barrier, indicates that lining the outer surface of the concrete with a thin layer of lead increases the efficiency of the shield. The results also show how exposure rates vary in-between the lead and concrete barriers, and how the γ-ray spectrum is modified in penetrating various shield combinations. (auth)

35520 (KAPL-P-3889) ANISOTROPIC SOURCES IN TWO-DIMENSIONAL TRANSPORT THEORY. Friedman, Jack P.; Crawford, Bruce W. (Knolls Atomic Power Lab., Schenectady, N. Y.). [1969]. Contract W-31-109-eng-52. 14p. (CONF-700608-1). Dep. CFSTI.

From American Nuclear Society Meeting, Los Angeles, Calif.

A method for treating anisotropy in multigroup transport theory is presented. Neutron scattering in each energy group is assumed to have the mathematical appearance of isotropic scattering. Extensions necessary for treating a Legendre polynomial expansion of the in-group scattering kernel are mentioned. Attention is confined to first-order spherical harmonics source moments. (M.H.R.)

35521 (ORNL-tr-2319) RADIATION SHIELDING OF A CYLINDRICAL SELF-ABSORBING SOURCE IN THE AXIAL DIRECTION. Krueger, F. W.; Seeligmann, P. Translated by R. Gregg Mansfield (Oak Ridge National Lab., Tenn.), from Kernenergie; 12: 390-4(1969). 6p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 24: 21844.

35522 (N-70-18127) MULTIGROUP RESONANCE-REGION CROSS SECTIONS FOR TUNGSTEN AND DEPLETED URANIUM FOR USE IN SHIELDING CALCULATIONS. Lahti, Gerald P.; Westfall, Robert M. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Jan 1970. 46p. (NASA-TM-X-1909; E-6155). CFSTI.

Multigroup capture and scatter cross sections in the resolved-resonance region were calculated for tungsten and depleted uranium slabs for use in shielding calculations of neutron transport and capture distributions. Slabs of thickness of 1 to 8 cm surrounded by hydrogen or lithium hydride were considered. CAROL was used to generate the cross sections, a method previously observed to preserve the total capture rate in a detailed multigroup neutron transport calculation for a thick resonance absorber. Average cross sections were calculated for a 32-energy-group split (0.4 to 1234 eV) compatible with that used by GAM-II. Group fluxes are also presented permitting further group collapsing either by hand calculations or with an included computer program. (auth) (STAR)

35523 ESTIMATE OF SPECTRA AND ABSORBED DOSES FOR SHIELDING AGAINST RADIATION RESULTING FROM ELECTRONS IN THE EARTH'S RADIATION BELT. Akkerman, A. F.; Beskrovnyi, I. M.; Nikitushev, Yu. M. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat., No. 6, 64-71(Nov.-Dec. 1968). (In Russian).

The spectra of electrons from the Earth's radiation belt in flat shielding of Al and plexiglas of thicknesses up to 2 g/cm^2 were calculated by the Monte Carlo method. Absorbed doses of bremsstrahlung were calculated. The results of the Monte Carlo calculations are compared with results of calculations made from range-energy relations. The appreciable deviation between the results of the two methods is explained by the neglect of multiple scattering in the method using range-energy relations. (tr-auth)

35524 THE ANALYTICAL APPROXIMATION OF THE ENERGY DEPENDENCE OF THE PHOTOELECTRIC ABSORPTION CROSS SECTION OF γ QUANTA. Marenkov, O. S. At. Energ. (USSR); 27: 462-3(Nov 1969). (In Russian).

In the statistical modeling of the transport of low-energy γ quanta by the Monte-Carlo method, the Compton scattering and the photoelectric absorption are usually taken into account. The former may be expressed analytically but there are no empirical or theoretical formulas to calculate the cross section of the photoelectric absorption for a given energy range and an atomic number Z. In order to facilitate approximation calculations, the attenuation coefficients of 14 elements—Al, Ca, Fe, Cu, Mo, Ag, Sn, Nd, W, Pt, Au, Pb, Po and U—were calculated by the least-squares method. The maximum error of the approximation was found to amount to 3.8%. (TTT)

35525 FREE-NUCLEON TARGET MODEL APPLIED TO PENETRATION AND DOSE CALCULATIONS FOR 200 AND 400 MeV PROTONS AND NEUTRONS. Wright, H. A.; Turner, J. E. (Oak Ridge National Lab., Tenn.). Health Phys.; 18: 711-20 (Jun 1970).

A new, simplified model for the transport of high energy neutrons and protons through matter is described. Nuclear interactions are treated by assuming nucleons in the target material to be free, initially at rest, and uniformly distributed in space. Calculations of the transport of 200 MeV and 400 MeV protons and neutrons through a 30 cm thick soft tissue slab are performed, and the results compared with an earlier, more detailed model. The absorbed dose within the slab as well as the number, angular distribution, and energy distribution of particles penetrating the slab are compared for the two models. The free-nucleon model gives results for certain dose and shielding calculations which are in agreement with those obtained by the detailed model. The free-nucleon model can, in principle, be extended to the highest energies for which experimental nucleon–nucleon and pion–nucleon cross sectional data exist. (auth) (UK)

35526 PROBLEMS OF ESTIMATING BIOLOGICAL RADIATION DOSES AND RADIATION PROTECTION IN SPACE. Buecker, H.; Voelker, W. pp 195-206 of Calcul des Doses de Radiations dans l'Espace. Elbaz, C. (ed.). Toulouse; Comptes Rendus de Journees Europeennes (1968).

From Calculation of Radiation Doses in Space Conference, Toulouse, France. See CONF-680219.

A discussion of radiation hazards and radiation protection in manned space operations requires considerations quite different from those that would apply to occupational exposure under terrestrial conditions. The recommendations concerning radiation protection on earth avoid exact determinations of the biological radiation doses by defining the maximum permissible doses under worst conditions, a large safety factor is involved. Considering requirements for radiation protection in manned space flight this approximation is not acceptable, for it does not lead to optimal safety of the entire mission, for by enlarged dead-weight-optimal shielding other risks could be increased. For this reason in manned space flight radiation hazards ought to be estimated as exactly as ever possible. Some radiations in space which might be biologically important are yet unknown in their physical parameters. Furthermore the biological efficiency of other radiations, which are mainly investigated, is still unknown. Therefore, radiation dosimetry and radiation protection in space require exact analyses of the three components of radiation in space in respect of their physical parameters and their biological effects. Some radiations were discussed in this manner. The radiation dose in a space ship and in the body of the astronaut mainly depends on secondary radiation and bremsstrahlung produced in the absorber. Because of the most complex conditions a calculation of the dose is not possible only from the data of the incident beam. (auth)

Solid-State Physics

Radiation Effects

Refer also to abstracts 33727, 33980, 33983, and 35801.

35527 (COO-1052-12) INVESTIGATION OF ENERGY TRANSFER PROCESSES BY FLASH PHOTOLYSIS (RADIATION EFFECTS IN SOLIDS). Final Report. Grossweiner, Leonard I. (Illinois Inst. of Tech., Chicago. Dept. of Physics). Jan 1970. Contract AT(11-1)-1052. 22p. Dep. CFSTI.

The research accomplished on this project falls into the areas: dye-sensitized photochemical oxidation of aqueous phenol; low-temperature photoequilibria between F and F′ centers; optical formation of F-aggregate centers and their spin-metastable states; effects of radiation on surface properties of alkali halide crystals; and mechanism of spectral sensitization of zinc oxide photoconductivity. A brief summary of each area is given. (W.D.M.)

35528 (COO-1054-46) ELECTRON-HOLE RECOMBINATION LUMINESCENCE AT A VACANCY PAIR. Manilerd, Chaleo (Wayne State Univ., Detroit, Mich.). 1970. 59p. Dep. CFSTI.

Thesis.

This thesis is concerned with luminescence properties associated with imperfection defects in alkali halides. Specifically, it employs the method of time-delayed luminescence to investigate the electron–hole recombination at the site of a vacancy pair (vacancy pair model). On the basis of the proposed model, the observed delayed luminescence spectra have been consistently interpreted. Furthermore, the activation energy for ionic diffusion, the ionization energy of an F^* center (excited F center), and the ionization energy of an F^1 center (F center with an additional electron) have been successfully evaluated. (auth)

35529 (ORO-3098-13) PROGRESS REPORT [ON RADIATION DAMAGE IN METALS]. Chaplin, R. L. (Clemson Univ., S. C.). Apr 1970. Contract AT(40-1)-3098. 13p. Dep. CFSTI.

ALUMINUM—radiation damage in single crystals of, effects of thickness on I_B substage of electron
—radiation damage annealing at 21 to 26° K in polycrystalline, effects of energy and copper dopant on electron
COPPER—effects on radiation damage annealing in aluminum
ELECTRONS—effects on single-crystal and polycrystalline aluminum at 0.2 to 0.4 MeV
—effects on magnesium, recovery of
MAGNESIUM—radiation damage in, studies of recovery of electron (D.L.C.)

35530 TRANSMISSION ELECTRON MICROSCOPY OF POINT-DEFECT CLUSTERS IN NEUTRON-IRRADIATED METALS. II. PLATINUM. Ruehle, M.; Haeussermann, F.; Rapp, M. (Max-Plank-Institut fuer Metallforschung, Stuttgart). Phys. Status Solidi; 39: 621-5(1 Jun 1970).

Annealed, neutron-irradiated, and neutron-irradiated and subsequently annealed platinum was investigated by means of transmission electron microscopy. In as-annealed platinum black dots were observed; these defects occurred only near the foil surfaces and were similar to the polishing defects in copper. Frank dislocation loops, prismatic dislocation loops, and voids were found in neutron-irradiated foils. After annealing for 1 hr at 543°K, the same defect types were observed; however, the contrasts of the defects were stronger. The results are compared with those of other authors. (auth)

35531 TRANSMISSION ELECTRON MICROSCOPY OF POINT-DEFECT CLUSTERS IN NEUTRON-IRRADIATED METALS. I. COPPER. Ruehle, M.; Haeussermann, F.; Rapp, M. (Max-Planck-Institut fuer Metallforschung, Stuttgart). Phys. Status Solidi; 39: 609-20(1 Jun 1970).

Neutron-irradiated copper was investigated by means of transmission electron microscopy. The nature of the point-defect clusters was determined by means of stereo microscopy. It is shown that the large defects are predominantly of interstitial type and the small defects of vacancy type. The densities and size distributions of the defects observed in differently pre-treated and irradiated foils were compared. It was found that only quantitative differences exist. Annealing experiments showed that the defect type and the size distribution of the defects are influenced by the annealing atmosphere. (auth)

35532 DEFECT STRUCTURE OF γ- AND X-IRRADIATED ALKALI HALIDE CRYSTALS. Kolontsova, E. V.; Linnik, V. M. (Moscow State Univ.). Sov. Phys.-Cryst. (Engl. Transl.); 14: 903-7(May-Jun 1970).

Translated from Kristallografiya; 14: 1044-9(Nov-Dec 1969).

Single crystals of LiF, NaCl, and KCl were studied by microscopic examination and selective etching before and after γ irradiation (7×10^6, 10^8, 10^9, and 2×10^9 R). The results obtained are compared with the results of studying the surface topography of the same type of crystals irradiated with x rays. (auth)

35533 STUDIES OF COLOUR CENTERS IN POTASSIUM CHLORIDE CRYSTALS. Soul, P. B. Warwick, Eng.; Univ. of Warwick (1970). 201p.

Thesis.

Low-energy (5-keV) electron irradiation was used to investigate the kinetics of color-center production to saturation in KCl crystals at energy-deposition rates between 10^{19} and 2×10^{21} keV cm^{-3} s^{-1}. Optical-absorption measurements of the F-center concentration (made after irradiation in the usual way) showed an asymptotic approach to a saturation level of about 3×10^{19} cm^{-3}, that is, independent of the dose rate. The rate of approach to saturation appears to be consistent with a model in which interstitial centers can either recombine with F centers or form stable clusters. Some "super-saturation" of the F-center level was noticed during coloration at the higher dose rates, although after the irradiation dose the absorption always decayed rapidly to the "normal"

level before measurements could be made. A second series of experiments was therefore carried out in which the heights of both the F-center absorption band and that due to M centers (F-center pairs) were monitored during irradiation. Under these conditions the F-center concentration rose to a peak level of between 4 and 7×10^{19} cm^{-3} (depending on the dose rate) and then descended slowly to an "equilibrium" value of about 3×10^{19} cm^{-3}, which was maintained indefinitely while irradiation continued. This pattern was followed over a wide range of dose rates, and the coloration curve was found to be essentially a function only of accumulated energy dose. A theory of saturation has been developed that is based on the statistical aggregation of F centers produced within a certain distance of each other. The conclusion drawn from these experiments is that the two processes of F-center aggregation and recombination with interstitial centers are probably of equal importance in determining the approach to saturation. The feasibility of using electron-coloration techniques in information-storage systems is discussed in the light of the results obtained in this research. A study has also been made of high-resolution "photographic" image recording on surface-colored KCl crystals and in thin evaporated films of PbI_2. (UK)

35534 EFFECTS OF THE ORDERED LOCATION OF ATOMS ON THE PENETRATION OF CHARGED PARTICLES IN MONOCRYSTALS. Shipatov, E. T. (Tomsk Polytechnical Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 8, 86-91(1969). (In Russian).

The angular and spectral distributions of protons with initial energies of 4 to 7 MeV in simple cubic ionic monocrystals and in monocrystals of Ge and Si were studied in order to observe the effects of the presence or absence of channeling. Mean energy losses of channeled and unchanneled protons in monocrystals were measured. The effect of concentration of defects in the structure of the monocrystals on the form of the energy spectra of the channeled protons is shown. For investigation of angular distribution of channeled protons, the method of photographic plates was used. The possibilities of a method of protonography for study of the structure and other characteristics of monocrystals are discussed. (tr-auth)

35535 DIFFUSION OF ANTIMONY IN SILICON THAT WAS SUBJECTED TO ION BOMBARDMENT. Panteleev, V. A.; Isavteeva, L. N. (Gorky Scientific-Research Physical-Technical Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 8, 27-30(1969). (In Russian).

A radioactive isotope of Sb was introduced by diffusion into the surface layer of Si. After irradiation by 55-keV helium ions to a dose of 2×10^4 μC diffusion annealing was carried out. Significant acceleration of diffusion in comparison with unirradiated specimens was discovered. Results are explained by a mechanism involving interstitial diffusion of Sb. (tr-auth)

35536 ANISOTROPIC X-RAY EXCITATION IN ALKALI HALIDES BY 75- AND 200-keV PROTONS. Roth, S. (New York Univ., N. Y.); Sizmann, R.; Coutelle, R.; Bell, F. Phys. Lett.; 32A: 119-20(15 Jun 1970).

Differences in channeling behavior along ⟨100⟩ (alternating sequence of alkali and halide atoms) and ⟨110⟩ (uniform alkali or halide rows) are investigated by means of characteristic x-ray production. (auth)

35537 RADIATION-INDUCED CURRENT AND PHOTON-INDUCED DEFLECTION OF ELECTRONS IN DIELECTRICS. Vladimirskii, A. B.; Vladimirskii, Yu. B.; Zakharov, G. M.; Nikitinskaya, T. L.; Rodnyi, P. A. (Leningrad Polytechnic Inst.). Sov. Phys.-Solid State (Engl. Transl.); 11: 3066-8(Jun 1970). Translated from Fiz. Tverd. Tela; 11: 3649-52(Dec 1969).

Measurements were made of currents induced by x radiation in LiF, NaF, and CaF_2 single crystals and in polyfluoroethylene resin in vacuum. Estimates were made of the photon-induced deflection of electrons and of the liberated charge carriers (Dember effect). The Dember effect was found to be small, increasing with effective atomic number. (D.L.C.)

35538 ELECTRON SPIN RESONANCE IN X-IRRADIATED SODIUM SULPHATE. PART II. Hariharan, N.; Sobhanadri, J. (Indian Inst. of Tech., Madras). Mol. Phys.; 18: 713-16(May 1970).

ESR results on single crystals of Na_2SO_4 grown at 35°C are presented and compared with earlier results (NSA 23: 23246) on the crystal grown at 65°C. The difference in the two investigations is due to the Sr^{2+} impurity in the crystal. Examination of the spectra at room and liquid nitrogen temperatures revealed the presence of hyperfine splitting. The large splitting observed suggests the possibility of some trapped hydride ions at vacancies. (auth) (UK)

35539 RADIATION CHANGES IN CERAMICS CONTAINING FREE SILICA. Belousov, V. M. Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 12, 7-10(1969). (In Russian).

Possible mechaniams of displacement of Si atoms in the crystal lattice of cristobalite ceramics upon irradiation and subsequent processes that lead to accumulation of Si in the pores of the material are considered. The maximum energy transmitted to a Si atom by Compton electrons was calculated. This energy was found to be 17400 eV for betatron radiation (15 MeV), 150 and 117 eV for the two components of γ radiation from a ^{60}Co source, and 7.6 eV for x rays (200 kV). The latter is less than the energy of displacement; this excludes the possibility of explaining the radiation changes upon x irradiation by the mechanism of the Compton effect. It is supposed that displacements of Si atoms in this case can be explained by a mechanism involving multiple simultaneous ionization of neighboring atoms by radiation, which facilitates their motion. From the fact that Si particles having dimensions on the order of tens of microns are formed in the pores of the material, it is concluded that the coefficient of diffusion of displaced atoms of Si in interstices increases by many orders under conditions of irradiation. (tr-auth)

35540 RELATIVE EFFECTIVENESS OF VARIOUS RADIATION SOURCES ON THE RESISTIVITY CHANGE IN n-TYPE SILICON. Jung, Wun (Korea Inst. of Science and Tech., Seoul). J. Korean Nucl. Soc.; 1: 91-101(Dec 1969).

Resistivity changes of n-type float-zone silicon crystals with 6.4×10^{14} to 1.25×10^{17} phosphorus atoms/cm^3 due to irradiation by (1) 1-MeV electrons, (2) two types of research reactors, and (3) ^{60}Co γ-ray sources were investigated. The results were analyzed on the basis of a simple exponential formula derived by Buehler. While the formula gave a fair fit in the low fluence range in most cases, the deviation was quite appreciable in the case of 1-MeV electron irradiation, and a linear change gave better fit in some cases. The large change in the carrier removal rate in electron-irradiated samples in the high fluence range was analyzed in detail in terms of the Fermi level cross-over of the defect levels. Based on the damage constants evaluated from the initial portion of data where the formula was applicable, the relative effectiveness of various radiation sources in causing the resistivity change in n-type silicon was compared. The TRIGA Mark II reactor neutrons, for example, were found to be about 40 times more effective than 1-MeV electrons. The dependence of the damage constant on the initial carrier concentration was also examined. The physical basis of the exponential law and the effect of the Fermi level cross-over of the defect levels on the resistivity change in the high fluence ranges are discussed. (auth)

35541 ABSORPTION, FLUORESCENCE, AND THERMOLUMINESCENCE IN GAMMA-IRRADIATED Pr^{3+}:LaF_3. Gravely, Ben T. (North Carolina State Univ., Raleigh). J. Chem. Phys.; 52: 3610-13(1 Apr 1970).

The thermoluminescence spectrum of gamma-irradiated Pr^{3+}:LaF_3 has been found to be identical to the unirradiated fluorescence spectrum. Three narrow-band glow curves are presented indicating agreement among the peaks in different spectral regions. An analysis of the trap depths is presented. (auth)

35542 SUPERVOIDS IN IRRADIATED ALUMINUM. Farrell, K.; King, R. T. (Oak Ridge National Lab., Tenn.). Phys. Status Solidi (a): 2: K5-7(16 May 1970).

Unusually large, oddly shaped voids were found in 99.999% pure Al sheet irradiated with a fast flux of 4×10^{20} n/cm^2 at 125 and 150°C. Besides the denuded zones along the grain boundaries, there are large voids of varying shapes: ribbons, faceted cylinders, plates, and equiaxed polyhedra. The voids formed by 10^{22} n/cm^2 at 60°C and the effects of preinjection with He or H_2 are described briefly. (D.L.C.)

35543 MIS ELECTROLUMINESCENT DIODES IN ZnTe. Donnelly, J. P.; Foyt, A. G.; Lindley, W. T.; Iseler, G. W. (Massachusetts Inst. of Tech., Lexington). Solid-State Electron.; 13: 755-8(Jun 1970).

It was observed that proton bombardment can be used to create high-resistivity layers in p-ZnTe, and this technique was used to fabricate avalanching MIS electroluminescent diodes. The breakdown voltages for these diodes ranged from approximately 6V for 50-ke V proton bombardments to 80V for 400-ke V proton bombardments. Diodes with a red spectral output as well as diodes emitting in the green luminescent band of ZnTe were obtained. The red electroluminescence appears to be due to an oxygen isoelectronic trap. The external quantum efficiency of the green diodes is 2×10^{-4} at room temperature and 10^{-3} at 77°K. That of the red diodes is 3×10^{-3} at room temperature and 4×10^{-3} at 77°K. (auth) (UK)

35544 RECOMBINATION LUMINESCENCE IN NaCl. Murray, R. B.; Dietrich, H. B.; Keller, F. J. (Univ. of Delaware, Newark). Contract AT(30-1)-3842. J. Phys. Chem. Solids; 31: 1185-8(May 1970).

A low-temperature luminescence arising from the recombination of an electron with a V_k center (self-trapped hole) has been identified previously in various alkali halides. Experimental proof that a particular emission band arises from the decay of a $(V_k + e^-)$ state can be achieved by orienting the V_k centers along one of the ⟨110⟩ directions, and then observing a linear polarization in the emitted light when electrons are released in the crystal and recombine with V_k centers. Previous work on NaCl revealed two prominent emission bands at low temperature, with peaks at 3.36 and 5.38 eV. These bands were attributed to $(V_k + e^-)$ recombination luminescence, although a positive identification by the polarization properties was not given. These emission bands in NaCl were further investigated. It is concluded that the high-energy band is definitely due to $(V_k + e^-)$ recombination and is σ polarized; the low-energy band is only weakly polarized (if at all) but does arise from $(V_k + e^-)$ recombination. (auth) (UK)

35545 INFLUENCE OF NEUTRON RADIATION ON THE CHARACTERISTIC QUANTITIES OF ALLOYED SEMICONDUCTOR GeSi. Macko, Pavel (Slovak Inst. of Tech., Bratislava). Fyz. Cas.; 20: No. 1, 36-47(1970).

The electric conductivity, Seebeck coefficient, thermal conductivity, and Z parameter of five samples of n-type GeSi were measured in the range of 100-400°K, after irradiation at 300°K with fast neutrons in doses of 0.1×10^{16}, 1×10^{17}, and 1×10^{18} n/cm^2. The experimental values are given in relatively simple expressions. Negative changes of all parameters begin to appear when the concentrations of the defects is greater than that of the inherent defects before the irradiation. (JPRS)

35546 AMORPHIZATION OF SILICON CRYSTALS ON IRRADIATION WITH FAST IONS. Gusev, V. M.; Martynenko, Yu. V.; Starinin, K. V. Sov. Phys.-Cryst. (Engl. Transl.); 14: 908-12 (May-Jun 1970).

Translated from Kristallografiya; 14: 1050-4(Nov-Dec 1969).

The minimum doses have been determined at which amorphization of surface layers of silicon is observed when irradiated by different ions. The experimental results are compared with a theoretical relationship between the amorphization dose and the atomic number Z of the ion Z_1, based on concepts relating to the growth of microscopic amorphous zones. (auth)

35547 COMMENTS ON DISLOCATION LOOPS IN NEUTRON-IRRADIATED TUNGSTEN BY J. M. GALLIGAN AND T. OKU. Smith, D. A. (Oxford Univ.). Phys. Status Solidi; 39: K101-3 (1 Jun 1970).

The identification of the defect in field-ion microscopic specimens of W (Galligan and Oku, Phys. Status Solidi, 36: K79(1969)) is considered from the viewpoint of current contrast theory. The origin of spirals and "horseshoes" is described. The extra half planes are shown to be perpendicular to the loop plane, indicating that collapse alone cannot be responsible for the defects. The evidence is inadequate for Galligan and Oku's assertion that vacancy condensation is the origin of the loop. (D.L.C.)

Physical Properties

Refer also to abstracts 34842 and 34935.

35548 INFLUENCE OF FOREIGN-METAL ENHANCEMENT ON THE GALVANOMAGNETIC EFFECTS IN CADMIUM CRYSTALS AT LOW TEMPERATURE. Schwarz, H. (Max-Planck-Institut fuer Metallforschung, Stuttgart). Phys. Status Solidi; 39: 515-26(1 Jun 1970). (In German).

Hall coefficient and magnetoresistivity of different single crystals of cadmium and of cadmium–zinc, cadmium–mercury, and cadmium–silver alloys were measured in dependence on crystal orientation at 4.2°K. The residual resistivity ratios of the samples ranged from 13,000 to 300. Both effects show strong deviations from Kohler's rule. The different results may be explained with the assumption that the solute atoms produce small-angle intersheet scattering. The probability of this scattering depends on the type of solute. (auth)

35549 HIGHLY RESOLVED X-RAY STRUCTURES AND THE ELECTRONIC STRUCTURE OF TUNGSTEN. Boehm, G.; Heyd, R. (Univ., Karlsruhe, Ger.). Phys. Status Solidi; 39: K19-21 (1 May 1970).

The structure of the short-wavelength limit of the continuous tungsten spectrum was resolved in the ultrasoft x-ray region. The spectrum is identified with the density of states above the Fermi level, confirming Mattheiss' calculations. Isochromate spectroscopy was also carried out, and similar results were obtained. A spherically bent dioctadecyladipate crystal was used in the spectroscopy. (D.L.C.)

35550 MAGNETIC PROPERTIES OF Nb_3X COMPOUNDS. Bernasson, M.; Descouts, P.; Fluekiger, R.; Treyvaud, A. (Univ., Geneva). Solid State Commun.; 8: 837-41(Jun 1970).

NMR and magnetic susceptibilities of Nb_3X compounds (X = Os, Ir, Pt, Pt–Au, and Au) were measured between room temperature and 15°K. Comparison with previous measurements of electronic specific heat and superconducting transition temperatures shows a rigid-band model behavior with a displacement of the Fermi level towards a peak in the density of states, and suggests some features in the electronic structure. (auth) (UK)

35551 FERMI SURFACE–BRILLOUIN ZONE EFFECTS IN fcc Bi–Tl ALLOYS. Claeson, T.; Oestklint, O. (Chalmers Univ. of Tech., Goteborg). Solid State Commun.; 8: 851-3(Jun 1970).

Anomalies in the lattice parameter, superconducting, and thermoelectric properties vs composition in fcc, Bi–Tl alloys indicate that a kind of Fermi surface–Brillouin zone interaction occurs. (auth) (UK)

35552 DETERMINATION OF THE FERMI SURFACE OF CADMIUM FROM THE ORIENTATION DEPENDENCE OF THE PERIOD OF SONDHEIMER OSCILLATIONS. Schwarz, H. (Max-Planck-Institut fuer Metallforschung, Stuttgart). Phys. Status Solidi; 39: 507-14(1 Jun 1970). (In German).

Sondheimer oscillations in the Hall coefficient of a cadmium single crystal with a resistivity ratio $\rho_{273°K}/\rho_{4.2°K} = 18{,}000$ were measured in dependence on crystal orientation. The results prove that the lens-shaped part of the Fermi surface in the third band is responsible for the strong Sondheimer oscillations observed on cadmium. A procedure was developed in order to determine this part of the Fermi surface very accurately from the orientation dependence of the period of the Sondheimer oscillations. The Fermi surface thus determined has rotational symmetry with regard to the hexagonal axis and agrees well with that found by means of other methods. The deviation from the nearly free electron model is very small. (auth)

35553 AKTUAL'NYE VOPROSY FIZIKI POLUPROVODNIKOV I POLUPROVODNIKOVYKH PRIBOROV. (Main Problems in Physics of Semiconductors and Semiconductor Devices). Kal'venas, S. P. (ed.). Vil'nyus, USSR; Institut Fiziki Poluprovodnikov Akademii Nauk Litovskoi SSR (1969). 308p.

Seven articles are included on the physics of semiconductors. Kinetic equations for strong electric fields, anisotropy of electrical conductivity of multisection semiconductors in strong electric fields, thermoelectromotive forces produced by current carriers, and recombination of current carriers in impurity centers in germanium and silicon are discussed in the first four articles. The last three articles cover the radiation damage to semiconductors, determination of parameters of the attachment levels in semiconductors by means of thermostimulated conductivity, and physics of the semiconductor surface. Extensive references are included for each article. (R.V.J.)

35554 DIRECT EVIDENCE FOR MAJORITY-CARRIER LOCATIONS IN THE BRILLOUIN ZONE OF GRAPHITE. Woollam, J. A. (Lewis Research Center, Cleveland). Phys. Lett.; 32A: 115-16(15 Jun 1970).

Thermoelectric power and Hall effect quantum resonances in graphite are used to locate the majority carrier electron and hole Fermi surfaces. The electron surfaces are found in the center of the Brillouin zone edge. (auth)

35555 MAGNETORESISTANCE AND HALL EFFECT OF DIBORIDES OF METALS OF THE IV B SUBGROUP. Malinskii, B. I.; Nemchenko, V. F.; L'vov, S. N. (Kherson State Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 12, 69-74(1969). (In Russian).

The dependence of the magnetoresistance and the Hall effect of TiB_2, ZrB_2, and HfB_2 on the effective magnetic field at room temperature and liquid-nitrogen temperature was studied. The concentrations and mobilities of the current carriers were calculated according to a two-zone model worked out for metals in which $n_1 = n_2$. Results are compared with results of calculations made using a one-zone model. (tr-auth)

35556 MAGNETIC STRUCTURE OF THE INTERMETALLIC COMPOUND $TbNi_5$. Lemaire, Remy; Paccard, Dominique (Centre National de la Recherche Scientifique, Grenoble, France). Compt. Rend., Ser. B; 270: 1131-3(4 May 1970). (In French).

At low temperatures, the hexagonal compound $TbNi_5$ shows a collinear magnetic structure whose direction of easy magnetization, situated in the basal plane, is in agreement with a calculation of the crystalline field effect. (France)

35557 EXPERIMENTAL STUDY OF THE ANISOTROPY OF THE PARAMAGNETIC SUSCEPTIBILITY OF SOME RARE EARTH ELEMENTS. Aleonard, Roland; Pauthenet, Rene CNRS, Grenoble, France). J. Phys. (Paris); 31: 213-18(Feb-Mar 1970). (In French).

An experiment for measurements of the paramagnetic susceptibility of single crystals is described; the magnetic field is applied along different orientations with regard to the crystallographic axes. The experimental results for some rare earth elements of the second sequence are presented. The effect of the shape of the sample on the definition of the intrinsic magnetic quantities of the substance is discussed. Paramagnetism is completely defined when the properties of both principal susceptibilities: $\chi_{int||c}$ parallel to the c axis, and $\chi_{int\perp c}$, in a direction in the basal plane are known. These susceptibilities are field independent in weak fields, then obey Curie–Weiss law with different paramagnetic Curie points. The variation of the inverse of the susceptibility of a polycrystal is shown to be a hyperbolic function of the temperature. (France)

35558 LARGE PEAK IN SPIN–PHONON INTERACTION IN Dy AT THE MAGNETICALLY SHIFTED CURIE TEMPERATURE. Lee, M. C.; Levy, M. (Univ. of California, Los Angeles). Phys. Lett.; 32A: 88-9(15 Jun 1970).

Ultrasonic attenuation measurements were performed on Dy by using 15-Mc/sec longitudinal waves propagating in the c-direction with a magnetic field oriented perpendicular to the c-axis. A large attenuation peak is observed at the Curie temperature, which may be caused by magnetization fluctuations. (auth)

35559 CRITICAL MAGNETIC BEHAVIOR OF EuO. Groll, G. (Technische Hochschule, Munich). Phys. Lett.; 32A: 99-100 (15 Jun 1970).

Combined recoilless γ-resonance and magnetization measurements indicate the existence of critical spin fluctuations and of critical superparamagnetism in EuO. (auth)

35560 ABSORPTION SPECTRUM OF Tm^{3+}:LaF_3. Carnall, W. T.; Fields, P. R.; Morrison, J.; Sarup, R. (Argonne National Lab., Ill.). J. Chem. Phys.; 52: 4054-9(15 Apr 1970).

The absorption spectrum of Tm^{3+}: LaF_3 was measured in the region 0.2 to 2.0 μ, which encompasses all but one of the excited states in the $4f^{12}$ configuration. Centers of gravity of the observed crystal-field components of each level were computed and used as the basis for determining the free ion energy level parameters. In addition to the electrostatic and spin–orbit interactions, the effects of configuration interaction and certain two-body magnetic interactions were considered. The theoretical analysis of the results yielded an excellent agreement between calculated and observed free ion levels. (auth)

35561 ELECTRICAL RESISTIVITY OF V–H ALLOYS. Westlake, D. G.; Ockers, S. T.; Gray, W. R. (Argonne National Lab., Ill.). Met. Trans.; 1: 1361-4(May 1970).

The electrical resistivity has been determined at temperatures between 120 and 500°K for V–H alloys with hydrogen concentrations from 0 to 42.1 at. %. A plot of the hydrogen solubility limit in vanadium shows that it increases from 0.5 at. % at 227°K to 26.4 at. % at 436°K. X-ray diffraction powder patterns indicated that alloys containing between 33.8 and 42.1 at. % H were single-phase, bct, β–V hydride at room temperature. The resistivity of the 33.8 at. % alloy closely approximated that of hydrogen-free vanadium, but the room-temperature resistivity increased with increasing hydrogen concentration at the rate of 1.7 microhm-cm per at. % H. These β alloys underwent one transformation at temperatures below 224°K and two more transformations near 450°K. The rationale has been based on increasing disorder of hydrogen in the interstices of the lattice with increasing temperature. (auth)

35562 EFFECT OF OXYGEN-DEFICIENCY ON ELECTRICAL TRANSPORT PROPERTIES OF TUNGSTEN TRIOXIDE CRYSTALS. Berak, James M.; Sienko, M. J. (Cornell Univ., Ithaca, N. Y.). J. Solid State Chem.; 2: 109-33(Jun 1970).

Single crystals of various substoichiometric tungsten trioxide crystals were prepared by vapor-phase transport and annealed under varying conditions. Electric resistivity, Hall voltage, and Seebeck coefficient were investigated as functions of temperature in the range 100 to 500°K and as functions of composition down to the compound $WO_{2.99}$. For stoichiometric WO_3 the results are in general agreement with previous reports. The jump in resistivity at the monoclinic–triclinic transition is due mainly to a decrease in electron mobility. The change in the triclinic–(low-temperature) transition is almost entirely the result of a large decrease in the carrier concentration. Changes in thermoelectric power cannot be explained on the basis of the ordinary electronic component; a lattice contribution must be present. Removal of oxygen pushes the transitions to lower temperatures, increases the carrier concentration, decreases the Hall mobility, and changes the spin of its temperature dependence. Segregation of oxygen defects apparently occurs even for $\chi < 0.0001$ in $WO_{3-\chi}$, and it is believed that the basic defect unit is not the oxygen vacancy but the Anderson–Hyde disk of shear. The upper bound for this type of defect structure appears to be at $\chi = 0.013$. The increase of mobility with increasing temperature is attributed to hopping of charge carriers in place of band processes in the defect regions. Decreases in the optical phonon drag and transport energy terms are needed to fit the thermoelectric power behavior of the monoclinic phase. X-ray studies show essentially no change in the cell parameters for the reduced crystals. There is strong optical absorption in the red and near-infrared associated with the oxygen deficiency, but only negligible paramagnetism. DTA studies show that the monoclinic–triclinic and triclinic–(low temperature) phase transitions are of the first-order and displacive type as in $BaTiO_3$; they are accompanied by transition heats of about 20 and 39 cal/mole, respectively. Measurements of resistivity and Seebeck coefficient on a $W_{20}O_{58}$ crystal suggest metallic-like behavior. (auth)

35563 MAGNETIC PROPERTIES AND ELECTRONIC STRUCTURE OF YTTRIUM HYDRIDES. Parks, C. Dean; Bos, William G. (Univ. of Louisville, Ky.). J. Solid State Chem.; 2: 61-7(Jun 1970).

Magnetic susceptibilities are reported for yttrium metal and its hydrides in the temperature range 123–300°K. The theory of the paramagnetism of conduction band electrons and crystal field considerations are applied in the interpretation of the susceptibilities and yttrium Knight shifts and spin–lattice relaxation times of yttrium metal and its hydrides. Predictions regarding the nature and occupancy of the conduction band in the hydrides are made for the cases of protonic and hydridic hydrogen. (auth)

35564 X-RAY DETERMINATION OF PHONON DISPERSION IN VANADIUM. Colella, R.; Batterman, B. W. (Cornell Univ., Ithaca, N. Y.). Phys. Rev., B; 1: 3913-21(15 May 1970).

Phonon frequencies along principal symmetry directions were measured in vanadium by means of thermal diffuse scattering of x rays. A polishing and annealing procedure was adopted which eliminated extra scattering associated with impurities. The dispersion curves have initial slopes in agreement with the measured elastic constants. No evidence was found for any irregularity at low frequencies in any of the dispersion curves and in the calculated frequency spectrum. A low-frequency peak in the frequency spectrum has been reported in two inelastic neutron-scattering experiments and was attributed to a Kohn effect. A Born–von Kármán model with seven-neighbor forces gave an adequate fit to the dispersion curves within experimental uncertainty. The derived interatomic force constants are not consistent with an axially symmetric model. The calculated frequency spectrum is in generally good agreement with the inelastic neutron determinations, but indicates the presence of more detailed structure. The high-energy tail observed in many experiments is not confirmed, nor does the $g(\nu)/\nu^2$ curve exhibit any hump in the low-frequency region. (auth)

35565 EVIDENCE FOR LARGE SPIN–ORBIT COUPLING IN METALLIC MOLYBDENUM. Cleveland, J. R.; Stanford, J. L. (Ames Lab., Iowa). Phys. Rev. Lett.; 24: 1482-5(29 Jun 1970).

Accurate measurements of the caliper dimensions of the molybdenum Fermi surface are reported. From these measurements, the separation between the electron jack and the hole octahedra along the ⟨100⟩ directions is estimated to be (7.5 ± 1)% of the ΓH dimension. This large separation implies that spin–orbit coupling is much greater than expected for metallic molybdenum. (auth)

35566 CRYSTALLOGRAPHIC AND MAGNETIC CHARACTERISTICS OF THE $Y_2Ni_{17-x}Cu_x$ SYSTEM. Carfagna, P. D.; Wallace, W. E.; Craig, R. S. (Univ. of Pittsburgh). J. Solid State Chem.; 2: 1-5(Jun 1970).

Crystallographic and magnetic characteristics of ternaries represented by the formula $Y_2Ni_{17-x}Cu$ were determined in an effort to establish why ferromagnetism in Y_2Ni_{17} (and also in Lu_2Ni_{17}) is lost with increasing temperatures in two stages. The a and c spacings both increase with increasing x (i.e., replacement of Ni by Cu). The saturation magnetization and the two transition temperatures decrease with increasing x. The initial decrease in saturation magnetization suggests that Cu transfer all its s electrons to Ni, where for $x > 2.6$ the decrease indicates a transfer of only 0.4 electron per Cu atom. Magnetization versus field at 4°K

shows two stages for certain of the ternaries. These results and the temperature dependence of magnetization are interpreted to indicate that there is an equilibrium between s and d electrons that is temperature- and field-sensitive for values of x between 2.5 and 3. Interpretations developed for the ternaries have been extended to Y_2Ni_{17}. The two stages of magnetization are ascribed to a change of electronic configuration of Ni (lower transition) with the concurrent change in moment and normal destruction of magnetic order at the upper transition point. The lower transition resembles the situation in elemental Ce where a change from +4 to the +3 state is brought on by changing temperature. (auth)

35567 LATTICE DYNAMICS OF TERBIUM. Houmann, J. C. Glyden; Nicklow, R. M. (Oak Ridge National Lab., Tenn.). Phys. Rev., B; 1: 3943-52(15 May 1970).

The frequency–wave-vector dispersion relation for the normal modes of vibration of terbium at room temperature was measured by means of slow-neutron inelastic scattering techniques. The triple-axis spectrometer at the Oak Ridge high flux isotope reactor was used, mostly in the constant-Q mode of operation. Phonon frequencies for wave vectors along the principal symmetry directions were determined and, in addition, measurements of phonon frequencies along the boundaries of the Brillouin zone and along a more general direction are reported. The data were fitted with a Born–von Kármán force model that includes interactions out to the eighth nearest neighbor. The interactions were assumed to be general (tensor) out to the fourth neighbor and axially symmetric beyond. The model was used to calculate a frequency distribution function $g(\nu)$ and related quantities such as the lattice specific heat and Debye temperature. (auth)

35568 X-RAY K-ABSORPTION EDGE OF NIOBIUM IN NIOBIUM METAL AND ITS OXIDES. Bhide, V. G.; Bahl, M. K. (National Physical Lab., New Delhi). J. Chem. Phys.; 52: 4093-6(15 Apr 1970).

The position and fine structure of the x-ray K-absorption edge of niobium in niobium metal and in its oxides have been investigated using a 400-mm bent crystal (mica) spectrograph. The K-absorption edge of niobium in its oxides shifts towards higher energy with respect to that in niobium metal; the shift is greater the higher the valence state of niobium. (auth)

35569 LOW-TEMPERATURE ELASTICITY AND MAGNETOELASTICITY OF DYSPROSIUM SINGLE CRYSTALS. Rosen, M.; Klimker, H. (Nuclear Research Center, Beer-Sheva, Israel). Phys. Rev., B; 1: 3748-56(1 May 1970).

The five independent adiabatic elastic constants of dysprosium were determined by means of an ultrasonic-pulse technique at a frequency of 10 MHz, between 4.2 and 300°K. The compressional elastic constants C_{11} and C_{33} display characteristic anomalies at the magnetic transition points T_N (178°K) and T_C (87°K). The shear constants C_{44} and C_{66} are very little affected at T_N; however, they exhibit typical anomalies at T_C. The temperature dependence of the directional compressibility $K_{S\parallel}$ parallel to the hexagonal c axis is qualitatively a mirror image of the perpendicular compressibility $K_{S\perp}$. Both are only slightly affected at T_N, but show drastic anomalies at T_C. At this transition, $K_{S\parallel}$ exhibits a hardening and $K_{S\perp}$ a pronounced softening of the crystal lattice. The limiting Debye temperature extrapolated to 0°K was found to be 190°K. The temperature dependence of the magneto-elastic energy shows a drastic change of 0.71 J cm^{-3} at T_C. Apparently, this change is responsible for the first-order phase transition in dysprosium at T_C. (auth)

35570 PRESSURE DEPENDENCE OF THE PARAMAGNETIC CURIE TEMPERATURE OF GADOLINIUM. Potter, Robert L.; Everett, Glen E. (Univ. of California, Riverside). Phys. Rev., B; 1: 3685-9(1 May 1970). (UCR-34P77-21).

The effect of hydrostatic pressure on the paramagnetic Curie temperature Θ, the ferromagnetic Curie temperature T_c, and the magnetic susceptibility in the region of short-range order in gadolinium was measured to 4.4 kbar. The pressure coefficients together with their standard deviations were determined to be $d\Theta/dP = -1.45 \pm 0.06$°/kbar and $dT_c/dP = -1.36 \pm 0.04$°/kbar and are the same to within the experimental uncertainty. This result suggests that, for a direct para-to-ferromagnetic transition, the two temperatures are of the same physical origin and are determined by the band structure in the paramagnetic region. (auth)

35571 PHOTOABSORPTION MEASUREMENT OF Li, Be, Na, Mg, AND Al IN THE XUV RANGE. Haensel, R. (Univ., Hamburg); Keitel, G.; Sonntag, B.; Kunz, C.; Schreiber, P. Phys. Status Solidi (a); 2: 85-90(16 May 1970).

The absorption structure of five light metals was measured from the onset of K and $L_{II,III}$ absorption up to photon energies of 140 eV (170 eV for Be). The edges at the threshold are followed by several broad peaks distributed over the total energy region covered by these measurements. There is a striking similarity between the $L_{II,III}$ absorption spectra of Na, Mg, and Al; a similarity can also be seen between the K-absorption spectra of Li and Be. (auth)

35572 MAGNETIC PROPERTIES OF U_3P_4–U_3As_4 SOLID SOLUTIONS. Trzebiatowski, Wlodzimierz; Misiuk, Andrzej (Inst. of Low Temperature and Structure Research, Wroclaw). Rocz. Chem.; 44: 695-6(1970).

U_3P_4–U_3As_4 solid solutions were prepared and found to preserve the Th_3P_4-type structure over the entire composition range. The Weiss constant and Curie temperature were measured and found to increase smoothly with U_3As_4 content up to ~70 mole %, and only slightly thereafter. Attempts to prepare solid solutions of U_3P_4, U_3As_4, and U_3Sb_4 showed no reaction between U_3P_4 and U_3Sb_4, a limited solid solubility (~5 mole %) between U_3As_4 and U_3Sb_4, and the formation of an antiferromagnetic phase in equimolar U_3As_4–U_3Sb_4. (D.L.C.)

35573 X-RAY SPECTRA, ENERGY BAND STRUCTURE, AND SUPERCONDUCTIVITY OF V_3X-TYPE COMPOUNDS. Nemnonov, S. A.; Kurmaev, E. Z.; Belash, V. P. (Inst. of the Physics of Metals, Sverdlovsk, USSR). Phys. Status Solidi; 39: 39-47(1 May 1970).

X-ray K-emission bands of the metal atoms from Me_3X-compounds (V_3Ga, V_3Si, V_3Ge, Cr_3Si) are investigated. A multiple-band structure of the energy spectrum is found characterized by a number of overlapping bands related to nonmetallic s-, p-, and metallic dp states. The results of theoretical calculations for V_3Ga, V_3Si, and V_3Ge (Mattheiss) are found to correlate well with experimental data. Some deviations, especially in the lower part of valence band, are attributed to the choice of the crystal potential. On the basis of experimental results, it seems possible to suggest theoretical calculations using a crystal potential corresponding to the $3d^34s^2$ vanadium atom configuration. The relationship between the electronic structure of Me_3X compounds and the change of their superconducting properties is discussed. (auth)

35574 LOW-TEMPERATURE NEUTRON-DIFFRACTION STUDIES ON Li(D,T). Anderson, J. L.; Bowman, A. L.; Arnold, G. P. (Los Alamos Scientific Lab., N. Mex.). J. Phys. Chem. Solids; 31: 1193-4(May 1970).

A considerable amount of evidence has been collected indicating that lithium tritide undergoes changes in lattice parameter, a_0, as a result of the tritium decay, provided the sample temperature is maintained below –7°C. This material does not, however, suffer these lattice changes when stored at higher temperatures. Pretzel (1962 and 1966) has suggested that this low-temperature lattice expansion is the result of the ^3He decay product occupying an interstitial position in the cubic lattice with the corresponding formation of an F center. This study was undertaken to verify Pretzel's data and to observe the changes in lattice parameter once this expanded salt is warmed to 23°C. (UK)

35575 LANDAU QUANTUM OSCILLATIONS OF THE VELOCITY OF SOUND IN Be: THE STRAIN DEPENDENCE OF THE FERMI SURFACE. Testardi, L. R.; Condon, J. H. (Bell Telephone Labs., Murray Hill, N. J.). Phys. Rev., B; 1: 3928-42 (15 May 1970).

Landau quantum oscillations of the velocity of sound in Be are reported. A general thermodynamic relation between the quantum oscillations of the velocity of sound (elastic moduli) and the strain dependence of the Fermi surface is given and is used to interpret the results. This relation shows that the amplitude of the oscillations is determined by the magnetic susceptibility and the strain dependence of the Fermi-surface extremal areas. An oscillatory as well as a monotonic Alpher–Rubin effect is obtained in this treatment. All major features of this theoretical result are generally verified in the experimental results. The strain dependence of the Fermi surface obtained in this work is in substantial agreement with previous hydrostatic pressure studies. At low temperatures, magnetic interaction effects modify the oscillation pattern. These results imply that the (differential) susceptibility at high frequencies is never paramagnetic. This behavior is shown to be consistent with the presence of magnetic domains whose walls are immobile at the sound frequency. Experimental techniques are also presented. (auth)

Moessbauer Effects and NMR

Refer also to abstract 33974.

35576 INFLUENCE OF PRESSURE ON THE SHAPE OF γ LINES EMITTED BY Sn NUCLEI RECOILING WITH 3 eV IN

Eu METAL. Kalus, J. (Bartol Research Foundation, Swarthmore, Pa.). Phys. Status Solidi; 39: 567-71(1 Jun 1970).

The deceleration of the ^{152}Sm nuclei recoiling with an energy of 3 eV after the electron-capture decay of ^{152}Eu, and thus the shapes of γ lines emitted after the neutrino emission, depends on the condition of the source material. The change of the γ-line shape of a Eu-metal source as a function of pressure was ascertained by measuring the yield of resonantly scattered 963-keV γ rays for pressures of 3.54 and 16.6 kbar. Features of the forces acting between the Sm atom and the Eu atoms are presented. In view of the low recoil energies involved and of the short lifetime of the nuclear state, the line shapes could be calculated to a good approximation by assuming that the recoiling nuclei were moving in a spherical potential. (auth)

35577 SPONTANEOUS EMISSION OF γ QUANTA BY A SYSTEM CONTAINING IDENTICAL NUCLEI. Pham duy Hien. Zh. Eksp. Teor. Fiz.; 58: 145-52(Jan 1970). (In Russian).

Spontaneous emission of gamma quanta by an excited nucleus in a poly- or single crystal containing identical (resonance) nuclei is considered. Expressions are obtained for the spectrum of γ quanta emitted without recoil (without change of the phonon state of the lattice) and also for the time dependence of the radiation rate in various directions. The problem is solved in the short-wave approximation $\lambda \ll a$ (λ is the photon wavelength, a the interatomic distance). The results can be experimentally verified by the usual method of measuring the lifetime of the nuclear excited state. (auth)

35578 TABLES OF NUCLEAR QUADRUPOLE RESONANCE FREQUENCIES. Biryukov, I. P.; Voronkov, M. G.; Safin, I. A. Hartford, Conn.; Daniel Davey and Company, Inc. (1969). 141p. $7.00. (IPST-Cat.-2218).

Translation of Tablitsy Chastot Yadernogo Kvadrupol'nogo Rezonansa by J. Schmorak.

This book presents a systematic summary of NQR frequencies of individual inorganic and organic compounds obtained inside and outside USSR up to the end of 1966. Bibliographies are included. (D.L.C.)

35579 MOESSBAUER EFFECT: APPLICATION TO RELATIVITY. Isaak, G. R. (Univ. of Birmingham, Eng.). Phys. Bull. (London); 21: 255-7(Jun 1970).

The combination of minute differences between predictions of classical mechanics and relativity theory on the one hand, and the great sensitivity and stability of the Moessbauer effect on the other, has given rise to the experimental work which is reviewed. Experimental tests of time dilatation resulting from microscopic motion in solids and from macroscopic velocities in the laboratory and also tests of the gravitational red shift of general relativity are discussed. A short account is given of a very sensitive aether drift experiment. (auth) (UK)

35580 INTERPRETATION OF THE MOESSBAUER ISOMER SHIFT IN ^{119}Sn. Emery, G. (Indiana Univ., Bloomington); Perlman, M. L. Phys. Rev., B; 1: 3885-6(1 May 1970).

The determination by the internal-conversion method of the fractional charge-radius change $\delta R/R$ for the 23.9-keV M1 transition in ^{119}Sn is re-examined. A modified $\delta R/R$ value is obtained; this is compared with values otherwise determined, and some implications of these comparisons are derived. (auth)

35581 MOESSBAUER ^{57}Fe SPECTRA FROM THE INTERMETALLIC COMPOUNDS $PuFe_2$, $NpFe_2$, AND UFe_2. Blow, S. (Atomic Energy Research Establishment, Harwell, Eng.). J. Phys., C (London); 3: 835-45(Apr 1970).

Using the isotope ^{57}Fe, a Moessbauer study of the three Laves-phase compounds $PuFe_2$, $NpFe_2$, and UFe_2 was made at 4°K, 77°K, and room temperatures. Both $PuFe_2$ and $NpFe_2$ exhibit magnetic splitting at room temperature, but UFe_2 displays only a quadrupole pair. This material has a Curie temperature of 195°K, and magnetic splitting is seen in the 77°K and 4°K spectra. It is deduced that for these three materials in the spin-ordered state, the hyperfine magnetic field points in a [111] direction, and that the magnetic spectra consist of two eight-line contributions, though the less-intense lines are not resolved. The low-temperature value of the hyperfine field was 105 ± 4 kG in $PuFe_2$, 50 ± 3 kG in $NpFe_2$, and 37 ± 3 kG in UFe_2; the separation of the quadrupole split peaks in UFe_2 at room temperature is measured as 0.47 mm sec^{-1}. Work on AFe_2 isotypes, where A is a rare-earth or other element, was carried out by a number of groups whose results are compared and contrasted with the present work. It is suggested that the actinide element exerts a first-order effect in determining the magnetic properties of the compounds investigated. (auth) (UK)

35582 SEARCH FOR ISOTOPE EFFECTS IN MOESSBAUER SPECTROSCOPY. I. EQUALITY OF TEMPERATURE SHIFTS FOR MOESSBAUER ABSORPTIONS OF ^{57}Fe IN ^{54}Fe AND ^{57}Fe IN ^{56}Fe. Begum, H. A. (Univ. of Birmingham, Eng.). J. Phys., C (London); 3: 846-50(Apr 1970).

The difference in line position for two absorbers, one of ^{57}Fe in ^{54}Fe and the other of ^{57}Fe in ^{56}Fe, was measured at room temperature and again at liquid-nitrogen temperature. In terms of line energy E(= 14.4 keV) and displacements ΔE from this energy, $(\Delta E_{54} - \Delta E_{56})_{77°K} - (\Delta E_{54} - \Delta E_{56})_{290°K} = (0.9 \pm 0.6) \times 10^{-15}$ E. If the actual Debye temperature of the host were the determining factor, a result of 4.2×10^{-15} would be predicted, but a null result is predicted by the concept of an effective Debye temperature $\theta_{eff} = \theta_{host}(M_{host}/M_{impurity})^{1/2}$ for an impurity in a lattice isotope with it. (auth) (UK)

35583 SEARCH FOR ISOTOPE EFFECTS IN MOESSBAUER SPECTROSCOPY. II. MAGNETIC HYPERFINE FIELD AT ^{57}Fe IN HOST LATTICES OF DIFFERENT ISOTOPES. Isaak, G. R.; Longworth, G. (Univ. of Birmingham, Eng.). J. Phys., C (London); 3: 851-4(Apr 1970).

The magnetic hyperfine fields at the ^{57}Fe nuclei in host lattices of ^{54}Fe, ^{56}Fe, and ^{57}Fe were compared at 295°K by a sensitive differential Doppler scanning technique. They were found to be the same within the experimental error of three parts in 10^4. (auth) (UK)

35584 EQUIPMENT FOR MEASURING THE MOESSBAUER EFFECT. Belogurov, V. N.; Vasil'ev, V. F. (Inst. of Physics, Riga). Latv. PSR Zinat. Akad. Vestis, Fiz. Teh. Zinat. Ser.; No. 2, 8-13(1970). (In Russian).

The equipment, provided with a feedback and a permanent acceleration and employing a multichannel analyzer AI-100, is described. The equipment enables one to stretch any half or any quarter of the velocity spectrum on the analyzer's 100 channels. A scheme for transferring the information on a teletype writer or a self-recorder is presented. (auth)

35585 INFLUENCE OF THE LATTICE POTENTIAL ON THE LINE SHAPE OF γ RAYS EMITTED BY Sm NUCLEI RECOILING WITH 3 eV IN Eu METAL AND EuO. Kalus, J. (Bartol Research Foundation, Swarthmore, Pa.). Phys. Rev., B; 1: 3569-76(1 May 1970).

The change in velocity of the ^{152}Sm nuclei recoiling with an initial energy of 3 eV after the electron-capture decay of ^{152}Eu, and thus the shapes of γ lines emitted after the neutrino emission, depend strongly on the source material. To scan these line shapes for polycrystalline ^{152}Eu metal and ^{152}EuO sources, these sources were placed on the periphery of an ultracentrifuge, and the yields of resonantly scattered 963-keV γ rays were measured for different source velocities. In view of the low recoil energies involved and of the short lifetime of the nuclear state, the line shapes could be calculated to a good approximation by assuming that the recoiling nuclei were moving in a spherical potential. With EuO single-crystal sources, a small variation (~1%) of the nuclear resonance fluorescence (NRF) yield was observed for different orientations of the crystal relative to the Sm scatterer. From this, an estimate of the amount of anisotropy in the potential was deduced. As a byproduct of the ultracentrifuge measurements, the difference in energy between the ground state of ^{152}Eu (9.3 hr) and the 0.963-MeV level of ^{152}Sm was determined to be 961.5 ± 5 keV, which is in agreement with other measurements. (auth)

35586 RESONANT CROSS SECTION FOR 14.4-keV GAMMA-RAY ABSORPTION IN ^{57}Fe. Johnson, Duane P. (Pratt and Whitney Aircraft, Middletown, Conn.). Phys. Rev., B; 1: 3551-4(1 May 1970).

The resonant cross section and internal conversion coefficients of the 14.4-keV level in ^{57}Fe are determined from Moessbauer absorption spectra of thin polarized iron foils. A value is given for the maximum resonant cross section of $(2.56 \pm 0.05) \times 10^{-18}$ cm^2, which leads to a total internal conversion coefficient of 8.19 ± 0.18. This value for the internal conversion coefficient is in excellent agreement with recent results from x–x-ray and x–γ-ray coincident experiments and is nearly 10% lower than the previously accepted value. (auth)

35587 LINEWIDTHS IN HIGH-RESOLUTION NMR SPECTRA. HOMOGENEOUS BROADENING DUE TO THE INTRAMOLECULAR DIPOLAR RELAXATION. Sykora, Stanislav (Politecnico, Milan). J. Chem. Phys.; 52: 4818-25(1 May 1970).

The theory of energy-level widths in coupled nuclear systems is discussed, and a detailed study of the intramolecular dipolar relaxations based on it is presented. The restrictions of the theory and all the approximations made are carefully discussed. The nuclear system coupling structure enters the formulas through relatively simple functionals defined over the unperturbed eigen-

vectors of the system. On the other hand, the spectral density functions, which appear as coefficients of these functionals, depend only on molecular geometry and motions. Both groups of parameters are thus to a great extent separated. In order to show the effectiveness as well as the limits of the method, the structure and the linewidths of resonance transitions of several simple systems (AB, A_2, ABX, A_2X, A_3, and A_3X) are studied in detail. (auth)

35588 COMPUTER CODE FOR EVALUATION OF COMPLEX MOESSBAUER SPECTRA. Hardy, K. A.; Russell, D. C.; Wilenzick, R. M.; Purrington, R. D. (Tulane Univ., New Orleans). Nucl. Instrum. Methods; 82: 72-6(1970).

A Fortran IV program is described that computes the expected Moessbauer spectrum for any isotope and for any source and absorber combination. The program calculates the spectrum for any range of values of magnetic field, gyromagnetic ratio, electric field gradient, quadrupole moment, asymmetry parameter, and angle of the magnetic field with respect to the electric field gradient. (auth)

35589 ELIMINATION OF H_1 INHOMOGENEITY AND SPIN–SPIN RELAXATION IN DETERMINATION OF SPIN–LATTICE RELAXATION TIMES. Van Putte, K. (Unilever Research Lab., Vlaardingen, Netherlands). J. Magn. Resonance; 2: 174-80(Mar 1970).

Inhomogeneity of the radiofrequency field and finiteness of the pulse length introduce a systematic error in the determination of the spin–lattice relaxation time by the null method. A simple experimental method is described by which these errors can be eliminated. By varying the inhomogeneity of the radiofrequency field, the formulae derived according to a classical model are compared with experimental results. After correction for these systematic errors, the accuracy of the spin–lattice relaxation time measurements is about 2%. (auth) (UK)

35590 HIGH-RESOLUTION NUCLEAR MAGNETIC RESONANCE BY FOURIER TRANSFORMATION. Freeman, R.; Jones, R. C. (Varian Associates, Palo Alto, Calif.). J. Phys. Chem.; 52: 465-6(1 Jan 1970).

One way to achieve improved resolution in NMR spectroscopy without slow sweep rates is to take the Fourier transform of the transient free induction signal after a short rf pulse. Proton spectra of the aldehyde resonances of 3-bromo-2(3H)-thiophenone and furan-2-aldehyde were measured using this method, and the long-range spin–spin couplings $J_{AX} = 0.05$ Hz and $J_{CX} = 0.06$ Hz were found. (D.L.C.)

Theoretical Physics

Refer also to abstracts 35676, 35689, and 35690.

35591 QUANTUM SYSTEM OF SCALAR PARTICLES. Boya, L. J. (Facultad de Ciencias, Valladolid, Spain. GIFT, Valladolid, Spain). Lett. Nuovo Cim.; 3: 643-9(16 May 1970).

It is shown for the $m > 0$ scalar case how the Wigner program produces a consistent and unique scheme for elementary systems. The group-theoretical support space is a functional space from which is constructed the Hilbert space of physical states with the usual probability interpretation of quantum mechanics—the 3-dimensional-momentum space. The Fourier transform is established for both spaces, which produces the covariant amplitude (in Minkowski space) and the Schroedinger amplitude (in ordinary, 3-dimensional R_3-space). The position operation, defined only in the latter space, is translated into the covariant space, yielding the Newton–Wigner operator. (L.B.S.)

35592 ADIABATIC THEORY OF MOTION OF CHARGED PARTICLES IN AN ELECTROMAGNETIC FIELD. Laval, G.; Pellat, R. (CENFAR, Paris. CERTS, Toulouse). pp 39-48 of Calcul des Doses de Radiations dans l'Espace. Elbaz, C. (ed.). Toulouse; Comptes Rendus de Journees Europeennes (1968). (In French).

From Calculation of Radiation Doses in Space Conference, Toulouse, France. See CONF-680219.

The essential results of the adiabatic theory are established: the guiding-center equations and the invariance of the magnetic moment and the longitudinal invariant are devised by using the asymptotic methods of the theory of nonlinear oscillations. (auth)

PHYSICS (HIGH ENERGY)

Particle Interactions and Properties (Experimental)

Refer also to abstract 35231.

35593 (SLAC-PUB-745) IMPORTANT PROBLEMS AND QUESTIONS FOR THE NEW ACCELERATORS. Drell, S. D. (Stanford Linear Accelerator Center, Calif.). May 1970. 34p. (CONF-700314-2). Dep. CFSTI.

From International Conference on Expectations for Particle Reactions at the New Accelerators, Madison, Wis.

A speculative discussion is given on particle interactions and properties to be discovered using very high energy accelerators. This discussion covers asymptotic projections, inelastic processes including deep inelastic scattering, the proton constituents of hadrons, and elastic scattering. (J.F.P.)

Electromagnetic

35594 (LNF-70/16) TOTAL AND DIFFERENTIAL CROSS SECTIONS OF NEGATIVE PION PHOTOPRODUCTION OFF NEUTRONS UP TO 1 GeV. POSSIBLE EVIDENCE FOR THE P_{11} RESONANCE. Note No. 472. Carbonara, F.; Fiore, L.; Gialanella, G.; (and others) (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 28 Apr 1970. 7p. Dep. CFSTI (U. S. Sales Only).

Some preliminary results are reported on the total and differential cross sections of the reaction $\gamma + n \rightarrow p + \pi^-$ from 1-GeV bremsstrahlung interacting in a deuterium bubble chamber. The main result found is a significant difference between the cross sections of π^+ and π^- photoproduction which appears in the second-resonance region. It is found that while the π^+ cross section shows the D_{13} peak at 1480 MeV, the bump for π^- is displaced backward at about 1400 MeV. (J.F.P.)

35595 COHERENT BREMSSTRAHLUNG ON A DIAMOND MONOCRYSTAL. Gorbenko, V. G.; Zhebrovskii, Yu. V.; Kolesnikov, L. Ya.; Miroshnichenko, I. I.; Romasko, L. M.; Rubashkin, A. L.; Sorokin, P. V. (Physical-Technical Inst., Kharkov). Yadern. Fiz.; 11: 1044-8(May 1970). (In Russian).

A quasimonochromatic polarized photon beam was obtained from a diamond monocrystal at the Kharkov 2-GeV electron linear accelerator. The coherent effect was investigated by measuring integral photon and secondary electron intensities as functions of the diamond orientation angles relative to the incident electron momentum. Intensity and polarization spectra of the photon beam are given. The photon polarization was estimated from the results of the (γ, p)-reaction studied in the first πN resonance region. (Physical-Technical Inst., Kharkov)

35596 MEASUREMENT OF THE $\gamma p\Delta(1236)$-VERTEX FORM FACTORS. Kajiura, N. (Hiroshima Univ.); Baba, K.; Hamatsu, R.; (and others) Lett. Nuovo Cim.; 3: 714-9(6 Jun 1970).

The results are reported of an experiment performed with a 1.3-GeV-electron beam, in which electrons were inelastically scattered from protons according to the reaction $e + p \rightarrow e + \Delta^+$ (1236, $\Delta^+(1236) \rightarrow p + \pi^0$. Observations were made on the protons decaying from the $\Delta^+(1236)$ in coincidence with the scattered electrons. The conclusions are as follows: the contribution of the scalar photon to the production of the $\Delta(1236)$ is negligibly small as compared with the transverse photon; and the $\gamma p\Delta(1236)$ vertex form factor shows a dependence similar to the proton form factor on the momentum transfer at least up to $q^2 = 8$ fm^{-2}. (L.B.S.)

35597 TOTAL AND DIFFERENTIAL CROSS-SECTIONS OF NEGATIVE-PION PHOTOPRODUCTION OFF NEUTRONS UP TO 1 GeV. POSSIBLE EVIDENCE FOR THE P_{11} RESONANCE. Lodi-Rizzini, E. (Univ., Pavia, Italy. Istituto Nazionale di Fisica Nucleare, Pavia, Italy); Mantovani, G. C.; Piazzoli, A.; (and others). Lett. Nuovo Cim.; 3: 697-703(30 May 1970).

Some preliminary results are reported on the reaction $\gamma + n \rightarrow p + \pi^-$ obtained by exposing a deuterium bubble chamber to a 1 GeV bremsstrahlung beam. The total and differential cross sections are reported for 20 intervals of the c.m. energy squared of the π^-p system. The possible existence of a P_{11} contribution in π^- photoproduction is considered. (L.B.S.)

35598 PHOTOPRODUCTION OF NEUTRAL PIONS FROM NEUTRONS BETWEEN 500 AND 900 MeV. Hemmi, Y. (Kyoto Univ.); Inagaki, T.; Kikuchi, R.; Maki, A.; Miyake, K.; Nakamura, T.; Sasaki, A.; Tamura, N.; Yasumi, S.; Okuno, H. Phys. Lett.; 32B: 137-9(8 Jun 1970).

The differential cross sections for the $\gamma + n \rightarrow \pi^0 + n$ reaction were measured at the photon energies of 500 to 900 MeV. The ratios, $R_{01} = [d\sigma/d\Omega(\gamma n \rightarrow \pi^0 n)]/[d\sigma/d\Omega(\gamma p \rightarrow \pi^0 p)]$, were obtained at the c.m. pion angles of 60°, 90°, 105°, 120° and 140°. (auth)

35599 WIDE-ANGLE BREMSSTRAHLUNG: ENERGY DEPENDENCE. Siemann, Robert Herman. Ithaca, N. Y.; Cornell Univ. (1969). 154p.

Thesis.

Pair production and colliding beam experiments have verified quantum electrodynamics for spacelike electrons, muons and photons. These experiments are insensitive to a possible breakdown of quantum electrodynamics caused by anomalous coupling of propagation of timelike electrons, muons or photons. One of the Bethe-Heitler amplitudes for electron bremsstrahlung, $e^- + A \rightarrow e^- + A + \gamma$, involves a timelike virtual electron (the other involves a spacelike virtual electron). Therefore, electron bremsstrahlung offers the opportunity of studying quantum electrodynamics for timelike virtual electrons; by making measurements at large angles it is possible to reach large timelike masses. In addition to the Bethe-Heitler amplitudes, a Compton-like amplitude contributes to the bremsstrahlung cross section. This amplitude depends on strong interactions and cannot be calculated exactly. Estimates indicate that this Compton-like amplitude contributes a total of less than 5% to the bremsstrahlung cross section in the mass region studied. The predictions of the Bethe-Heitler amplitudes must be corrected for radiative effects and the elastic and inelastic form factors of the nucleus; these corrections are discussed in detail. The radiative correction is typically 12% and the form factor corrections range from 3% to 25%. The background due to π^0 electroproduction is estimated from the well-known relation to photoproduction and is less than 1% of the bremsstrahlung cross section. The internal beam of the Cornell 10 GeV electron synchrotron was used to study bremsstrahlung from carbon and copper. The scattered electron and photon were detected in coincidence; correlated pulse height techniques were used to identify bremsstrahlung events. The photons were detected at 6.4° with a lead-glass Cerenkov counter. The electrons were detected at 6.2° by a single focusing spectrometer with two apertures. This detection geometry was not changed during the course of the experiment; the timelike and spacelike masses of the virtual electrons were varied by changing the incident energy. The two electron apertures were arranged such that one aperture was sensitive to bremsstrahlung, the other to background processes. A large bremsstrahlung cross section for this latter aperture would be an indication of background troubles. The incident beam was monitored by observing the forward bremsstrahlung; elastic electron-proton scattering indicated that the absolute normalization of the experiment was good to 5%. Fifteen measurements of the bremsstrahlung cross section were made with incident energies ranging from 2.5 to 9.5 GeV; the timelike mass range covered by these measurements was from 270 to 1035 MeV/c^2. Carbon was the target for fourteen measurements; copper was the target for the fifteenth. The ratio of the cross sections from carbon and copper agreed with the predictions of theory. The two electron apertures showed the expected behavior; this is a strong indication of no significant background problems. The data of the aperture sensitive to bremsstrahlung agreed with the predictions of quantum electrodynamics. The ratio of experiment and theory R, has been fit with curves quadratic and fourth power in the timelike mass of the virtual electron, M. The two-standard deviation upper limits to the slopes of these fits are $1/\Lambda_2 = (1/2\ dR/dM^4)^{\frac{1}{2}} < 5.5 \times 10^{-15}$ cm, $1\Lambda_4 = (1/2\ dR/dM^4)^{\frac{1}{4}} < 11 \times 10^{-13}$ cm. No evidence of the existence of an excited state of the electron was seen in the mass region covered by this experiment. (Diss. Abstr. Int., B)

Weak

35600 (UCRL-19709) WEAK INTERACTIONS: ON THE EXISTENCE OF NEUTRAL LEPTONIC CURRENTS. Johnson, Roland P. (California Univ., Berkeley. Lawrence Radiation Lab.). 2 Apr 1970. Contract W-7405-eng-48. 69p. Dep. CFSTI.

Thesis.

New upper limits to the branching ratios for $K_L^0 \rightarrow \mu^+\mu^-$, $K_L^0 \rightarrow e^+e^-$, and $K_L^0 \rightarrow \mu^+e^-$ were set. A two-armed spectrometer system for the simultaneous detection of these decay modes and the normalizing $K_L^0 \rightarrow \pi^+\pi^-$ mode is described. No events of the $\mu\mu$, ee or μe type were observed. Twenty-three thousand $K_L^0 \rightarrow \pi^+\pi^-$ events with detection efficiency corrections then determine

new branching ratio upper limits relative to all K_L^0 modes of 1.1×10^{-7} (90% C.L.) for all three leptonic modes. (auth)

35601 SEARCH FOR THREE-VECTOR CORRELATION IN POLARIZED NEUTRON DECAY. Erozolimskii, B. G.; Bondarenko, L. N.; Mostovoi, Yu. A.; Obinyakov, B. A.; Zakharova, V. P.; Titov, V. A. (Inst. of Atomic Energy, Moscow). Yadern. Fiz.; 11: 1049-57(May 1970). (In Russian).

The value of the constant D of the triple correlation between the vectors of the neutron spin σ and the directions of the electron and antineutrino momenta p_e and p_ν is found to be -0.01 ± 0.01. The corresponding phase shift between axial-vector and vector constants of the weak interaction is $\varphi = 181.3 \pm 1.3°$. (auth)

35602 EXPERIMENTAL STUDY OF THE DECAY SPECTRUM OF $K_L^0 \to \pi^+\pi^-\pi^0$. Smith, R. C. (Univ. of Maryland, College Park); Wang, L.; Whatley, M. C.; Zorn, G. T.; Hornbostel, J. Phys. Lett.; 32B: 133-6 (8 Jun 1970).

A wide-gap-chamber experiment was performed to study the decay of the K_L^0 meson into $\pi^+\pi^-\pi^0$. If the matrix element for this decay is parametrized in the form $M \propto 1 + \alpha\,(m_K/m_\pi^2)(2T_{\pi^0} - T_{\pi^0 max})$ the value of α from this experiment is $\alpha = -0.311 \pm 0.026$. The error estimated here includes uncertainties in systematic errors. The data also provide a measure of the charge asymmetry: $(N_+ - N_-)/(N_+ + N_-) = 0.000 \pm 0.018$. (auth)

Strong (Baryon-Induced)

Refer also to abstract 35862.

35603 (CERN-70-12) HIGH-ENERGY PARTICLE SPECTRA FROM PROTON INTERACTIONS AT 19.2 GeV/c. Allaby, J. V.; Binon, F.; Diddens, A. N.; (and others) (European Organization for Nuclear Research, Geneva (Switzerland)). 23 Apr 1970. 44p. Dep. CFSTI (U. S. Sales Only).

Proton interactions with protons and reactions with B_4C, Be, Al, Cu, and Pb nuclei at 19.2 GeV/c are reported. The purpose of the experiment is to obtain a dense set of data points in the region where the produced particles are restricted to a forward cone characterized by an average-transverse momentum of about 400 MeV/c. Also information is given up to the highest possible secondary momenta for all the types of particles. Tables of data for these reactions are included. (J.F.P.)

35604 (SJC-P-70-2) SYSTEMATIC INVESTIGATION OF ULTRA HIGH ENERGY INTERACTIONS. [PART] II. Nozaki, T.; Koshiba, M. (Tokyo Univ. (Japan). Inst. for Nuclear Study). Apr 1970. 93p. Dep. CFSTI (U. S. Sales Only).

The composition of secondary particles produced in the backward cone of nuclear interactions of 10^{12} ev to 10^{13} ev was investigated by means of a large emulsion stack. The angular distributions in the center of mass system of protons, $K^\pm$ mesons and $\pi^\pm$ mesons were observed to have their respective peaks in the narrow, $\lesssim 0.2$ radian, angular region around the backward direction. The $K^\pm/\pi^\pm$ ratio in the peak was found to be 0.71 ± 0.20. The $K^\pm$ mesons in the peak are likely to be the decay products of ϕ mesons produced with small emission angles. Finally with additional experimental data the "Aleph" isobar proposed previously is examined. (auth)

35605 (SJC-P-70-3) DETAILED INVESTIGATION OF AN 80 TeV NUCLEAR INTERACTION. Nozaki, T. (Tokyo Univ. (Japan). Inst. for Nuclear Study). Apr 1970. 86p. Dep. CFSTI (U. S. Sales Only).

An 80-Tev nuclear interaction of type (15 + 15 + 49) p detected in a large emulsion stack was analyzed in detail. The target diagram of charged secondary particles and γ-rays in the extreme forward cone together with their energy estimates was found to be consistent with the production of an Aleph baryon and its subsequent decay into $(p + \phi)$ in the extreme forward cone. The masses of the wide angle secondary charged particles were identified and the results were found to be consistent with the production of an Aleph baryon decaying into $(p + \phi)$ in the extreme backward cone of the center of mass system. (auth)

35606 (UCRL-19737) THE MESON SPECTRUM IN THE REACTION PP → d MM. Wicklund, Arthur Barry (California Univ., Berkeley. Lawrence Radiation Lab.). Mar 1970. Contract W-7405-eng-48. 183p. Dep. CFSTI.

Thesis.

A spark-chamber spectrometer is used to study the meson spectrum in the reaction $p + p \to d + MM$ at 3.8 to 6.3 GeV/c. Evidence is found for the production of an isospin-1 resonance in the $p + p \to d + \delta^+$ reaction. This resonance has a mass of 975 MeV and a width of 60 MeV. (J.F.P.)

35607 NEUTRON-PROTON BREMSSTRAHLUNG MEASUREMENTS AT 208 MeV. Young, John Chancellor. Davis, Calif.; Univ. of California (1969). 137p.

Thesis.

The free neutron-proton bremsstrahlung cross section was measured using a liquid hydrogen target and a 208-MeV neutron beam produced by the stripping of 440-MeV deuterons on Be. Measurements were made in the Harvard geometry with $\Theta_n = \Theta_p = 30°$, $32\frac{1}{2}°$, 35°, 38°; and at two unequal angle cases with $\Theta_p = 30°$, $\Theta_n = 40°$ and 45°. The results are in good agreement with the one-pion-exchange predictions of McGuire, a factor of 1.7 larger than the model independent calculations of Nyman, and the 30° point is six times larger than the 6 $\mu b/sr^2$ predicted by Pearce, Gale, and Duck using the Tabican separable potentials. A comparison with the experimental ppγ results of Thorndike indicates that in the Harvard geometry, the ratio of npγ/ppγ is almost 4 in contrast to a ratio of 50 which the Rochester group obtains for the total npγ to ppγ cross sections for E_γ greater than 40 MeV. (Diss. Abstr. Int., B)

35608 ANALYSIS OF REACTIONS OF THE TYPE pp → Δ^{++} + M AT 28.5 GeV/c; ROLE OF PION EXCHANGE IN HIGH ENERGY SCATTERING. Ellis, W. E.; Kinsey, R. R.; Morris, T. W.; Panvini, R. S. (Brookhaven National Lab.; Upton, N.Y.). Phys. Lett.; 32B: 140-4 (8 Jun 1970).

Reactions of the $p + p \to \Delta^{++}$ (1238) + M are studied at 28.5 GeV/c incident momentum. Cross sections of the various channels that constitute M suggest the importance of pion exchange at the Δ^{++} vertex. (auth)

35609 INTERACTIONS DUE TO HIGH-Z PARTICLES IN THE PRIMARY COSMIC RAYS. Young, Philip John. Auburn, Ala.; Auburn Univ. (1969). 65p.

Thesis.

A study was made of the nature of 17 interactions in nuclear emulsions of high Z charged particles in the primary cosmic ray flux. The charges of the primary particles were determined by means of their delta-ray densities. The masses and energies of the secondary particles were determined by means of their grain densities and multiple Coulomb scattering. Among the secondary particles, 8 protons, 18 pions, 2 kaons, 3 deuterons, and 6 alphas were identified. An estimate of the average number of nucleon collision pairs per event was made and found to be $1.7 \pm .3$. (Diss. Abstr. Int., B)

Strong (Meson-Induced)

35610 (COO-1428-207) DOUBLE-REGGE-POLE ANALYSIS OF $\pi^+p \to \pi^+\rho^0p$ AT 13.1 GeV/c. Gaidos, J. A.; Ezell, C. R.; Lamsa, J. W.; Willmann, R. B. (Purdue Univ., Lafayette, Ind.). [1970]. Contract AT(11-1)-1428. 33p. Dep. CFSTI.

A double-Regge-exchange analysis of the reaction $\pi^+p \to \pi^+\rho^0p$ at 13.1 GeV/c is presented. The events are divided into proton diffractive (~80%) and pion diffractive (~20%) categories, each of which requires two double-Regge amplitudes for a complete description. The data of each sample are well described by a double-Regge model consistent with duality. (auth)

35611 EVIDENCE FOR THE EXISTENCE OF THE $A_1(1070)$ AND SOME OTHER STRUCTURES OBSERVED IN π^-p COLLISIONS AT 11.2 GeV/c. Caso, C. (Univ., Genoa. Istituto Nazionale di Fisica Nucleare, Genoa); Conte, F.; Tomasini, G.; (and others). Lett. Nuovo Cim.; 3: 707-13(6 Jun 1970).

The $(3\pi)^-$ and $\rho^0\pi^-$ mass spectra of various reactions from a π^-p experiment at 11.2 GeV/c are compiled. The $A_1(1070)$ enhancement is clearly seen; the results support the interpretation of the A_1 (1070) as a resonance. In the four-prong reactions, an indication of an enhancement is seen in the region of the $\Delta^{++}(3230)$ isobar. Several enhancements are seen in the mass spectra of the $(4\pi)^-$ system produced in the reaction $\pi^-p \to p\pi^+\pi^-\pi^-\pi^0$. (L.B.S.)

35612 BACKWARD RHO PRODUCTION IN π^-p REACTIONS AT 2.3 BeV/c. Hagopian, S. (Univ. of Pennsylvania, Philadelphia); Hagopian, V.; Bogart, E.; O'Donnell, R.; Selove, W. Phys. Rev. Lett.; 24: 1445-8(22 Jun 1970).

In a sample of 8300 events of the type $\pi^-p \to \pi^-\pi^+n$ and 6800 events of the type $\pi^-p \to \pi^-\pi^0p$ obtained with 2.3-BeV/c incident π^-, substantial backward ρ^0 production is seen. The decay angular distribution of these backward ρ^0 events was found to be anisotropic. The u distribution for the backward ρ^0's is compared with the theoretical predictions of the strong-cut Reggeized absorption model. A small amount of backward ρ^- production is also seen. (auth)

35613 PION PRODUCTION IN HYPERON AND $K^0\bar{K}^0$ CHANNELS IN π^-p INTERACTIONS AND MULTIPION PHOTOPRO-

DUCTION. Wang, C.P. (Case Reserve Univ., Cleveland). Phys. Lett.; 32B: 125-8 (8 Jun 1970).

Pions produced in $\Sigma^{\pm}K^0$, ΛK^0, $K^0\bar{K}^0$ and $n\pi^+\pi^-$ channels in π^-p interactions and photoproduced from proton are shown to follow the quantum-number conserved $W^1(\pi)$ distribution which is thus a characteristic of high energy collisions (≤900 GeV), including photon-nucleon interactions. (auth)

35614 STUDY OF THE LAMBDA LEPTONIC DECAY OF THE SIGMA HYPERON. McFadyen, John Harold. Stony Brook, N. Y.; State Univ. of New York (1969). 88p.

Thesis.

There were 550,000 pictures taken of the interactions of a stopping K^- meson beam in the thirty-inch hydrogen bubble chamber at Brookhaven National Laboratory. The film was completely double-scanned for the reaction sequence $K^- + p \rightarrow \Sigma^+ + \pi^-$, $\Sigma^+ \rightarrow \Lambda^0 + e^+ + \nu$, $\Lambda^0 \rightarrow p + \pi^-$. There were 46 events with a negative sigma hyperon, and 6 events with a positive sigma hyperon identified, reconstructed with TVGP, and kinematically analyzed by SQUAW. Branching ratios for the two modes were determined to be as follows: ($\Sigma^- \rightarrow \Lambda\, e^-\, \nu$/all Σ^- decays) = (0.52 ± 0.09) × 10^{-4}, ($\Sigma^+ \rightarrow \Lambda\, e^-\, \nu$/all Σ^+ decays) = (0.16 ± 0.07) × 10^{-4}. With a Cabibbo angle of 0.288, the former result leads to values of $D^{\Delta} = 0.69 \pm 0.06$ and $\alpha = 0.59 \pm 0.05$. In addition, a likelihood function for all 52 events shows the most likely value of G_V/G_A to be -0.7 ± 0.4 when the time reversal violating term is omitted from the matrix element for the complete decay sequence. If this term is included the best value for the ratio is $\sim -0.6 - 0.5i$. (auth)

Particle Interactions and Properties (Theoretical)

Refer also to abstract 35898.

General

Refer also to abstracts 35591, 35698, and 35724.

35615 (JINR-E2-5141) COHERENT STATE METHOD IN THE PROBLEMS OF HIGH-ENERGY HADRON INTERACTIONS. Matveev, V. A.; Tavkhelidze, A. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1970. 24p. Dep. CFSTI (U. S. Sales Only).

A model of high-energy hadron interactions based on the assumption of a coherent nature of the excited states of colliding hadrons is discussed. In the model described, the degeneration of the states is given by a four-dimensional relativistic oscillator which takes the role of some collective variable. The wave functions of the hadron coherent states are determined and their properties studied. Models of elastic and inelastic high-energy hadron interactions are considered. The coherent-state vectors are used for the factorization of the scattering amplitudes satisfying a subsidiary integral representation. (J.F.P.)

35616 (JINR-E2-5182) METHOD OF COHERENT STATES AND DIAGRAM TECHNIQUE FOR DUAL AMPLITUDES. Kvinikhidze, A. N.; Markovski, B. L.; Stoyanov, D. Ts.; Tavkhelidze, A. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1970. 24p. Dep. CFSTI (U. S. Sales Only).

A factorization of the dual amplitudes based on the method of coherent states is obtained. Diagram technique for construction of N-particle dual amplitudes by using a finite number of operators is investigated. (auth)

35617 (NYO-2262-TA-220) PROGRESS REPORT FOR A RESEARCH PROGRAM IN THEORETICAL HIGH-ENERGY PHYSICS. Feldman, David (Brown Univ., Providence, R. I. Dept. of Physics). 1 Jun 1970. Contract AT(30-1)-2262. 9p. Dep. CFSTI.

A summary of research on theoretical high-energy physics at Brown University for the year from September 1, 1969 to August 31, 1970 is presented. Theoretical papers published during the past year and papers in press are listed. (J.F.P.)

35618 AMPLITUDE OF SCATTERING OF A NONVACUUM REGGEON BY A PARTICLE. Laperashvili, L. V. (Inst. of Physics, Tbilisi, USSR). JETP Lett. (USSR) (Engl. Transl.); 11: 206-10(20 Mar 1970).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 11: 312-16(20 Mar 1970).

The Veneziano model is used to calculate the amplitude for the scattering of a nonvacuum Reggeon by a particle. The Reggeon-particle scattering amplitude is obtained by the factorization of the six-point diagram. (J.F.P.)

35619 PERTURBATION THEORY FOR POTENTIALS WITH CORE. Badalyan, A. M.; Simonov, Yu. A. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 11: 1112-24 (May 1970). (In Russian).

Two-particle interaction consisting of two parts, external interaction and internal one (core) with small radius, is considered. Exact equations are given that are derived from the Schrödinger equation, the external interaction being described by the potential and the internal by the t-matrix off the energy shell. The wave function and the binding energy are described as an expansion in powers of the core radius. It is shown that in the first two orders they are expressed by a single parameter representing the core — the scattering length. Realistic numerical examples for a repulsing core are given which show the convergence of the expansions. (Inst. of Theoretical and Experimental Physics, Moscow)

35620 SUPERCONVERGENCE, CURRENT ALGEBRA, AND SUM RULES. Furlan, G. (Univ., Trieste, Italy). pp 1-136 of Elementary Particle Physics and Scattering Theory. Vol. 1. /Chretien, M. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1970).

The discussion of superconvergence, current algebra, and sum rules covers the general current-algebra relations, generalization to spin-½ targets, sum rules, invariant decomposition and partial-wave expansion, and the asymptotic behavior of weak and strong amplitudes. Applications of current-algebra and superconvergent sum rules, a model for the saturation of superconvergence and current-algebra sum rules, and the general formulation of current algebra and superconvergence are also covered. (J.F.P.)

35621 PARTICLES AND SOURCES. Schwinger, Julian (Harvard Univ., Cambridge, Mass.). pp 209-305 of Elementary Particle Physics and Scattering Theory. Vol. 1. /Chretien, M. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1970).

A totally new approach to particle physics is discussed. The source theory concept is intermediate between quantum field theory and S-matrix theory. This source theory is found to reproduce and improve results of other formulations without unnecessary assumptions. Noninteracting particles and electrodynamics are discussed. (J.F.P.)

35622 CURRENT ALGEBRA. Weisberger, W. I. (Princeton Univ., N. J.). pp 363-462 of Elementary Particle Physics and Scattering Theory. Vol. 1. /Chretien, M. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1970).

The applications of current algebra are covered. The currents and their equal-time commutation relations, sum rules for the renormalization of strangeness-conserving axial-vector current, low-energy predictions for $\pi + N$ scattering, low-energy photopion production, and $\pi - \pi$ scattering lengths and K leptonic decay are considered. Also included are nonleptonic decays and $\eta \rightarrow 3\pi$ decay, local commutation rules, testable predictions of local commutation relations, and dynamical schemes for current-algebra results and open problems. (J.F.P.)

Electromagnetic

Refer also to abstracts 35648, 35661, 35662, 35697, 35699, and 35913.

35623 (ITF-70-19) PHOTOPRODUCTION OF PSEUDOSCALAR MESONS ON PROTONS AND MIXING ANGLE OF ISOSINGLETS η_1 AND η_8. Kobylinskii, N. A. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1970. 9p. (In Russian). Dep. CFSTI (U. S. Sales Only).

The processes of the photoproduction of π^0 and η mesons on protons are considered within the framework of a model taking into account poles and cuts with the aim of definition of the mixing angle of isotopic singlets η_1 and η_8. The possibility is shown of definition of sign of amplitudes and of widths of the two photon decays of pseudoscalar mesons in their photoproduction on protons. (auth)

35624 (ITF-70-21) PHOTOPRODUCTION OF NEUTRAL PSEUDOSCALAR MESONS ON NUCLEI. Kobylinskii, N. A. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1970. 9p. (In Russian). Dep. CFSTI (U. S. Sales Only).

The processes of the meson photoproduction on nuclei are considered in a model taking into account poles and cuts parameters which are connected in the impulse approximation with those of contributions from these singularities to the amplitude of the meson photoproduction on nucleons. The possibility is shown of definition of the relative sign of Coulomb and Regge amplitudes in the processes of the coherent meson photoproduction on nuclei with zero isospin. (auth)

35625 (SLAC-PUB-736) ELECTROMAGNETIC INTERACTIONS AT VERY HIGH ENERGY. Bjorken, J. D. (Stanford Linear Accelerator Center, Calif.). May 1970. 21p. (CONF-700314-1). Dep. CFSTI.

From International Conference on Expectations for Particle Reactions at the New Accelerators, Madison, Wis.

Scaling laws which suggest how to extrapolate to higher energies for hadron interactions are discussed. These scaling laws have some basis from experimental data. This includes two-body and quasi-two-body photoproduction and deep inelastic electroproduction. Also scaling behavior based more on theoretical conjecture than on experimental data is considered. These scaling laws include the productions for single-particle spectra according to Feynman and Yang, and conjectures for hadron yields in colliding-beam experiments. Other miscellaneous electromagnetic topics are also considered. (J.F.P.)

35626 ESTIMATE OF THE CONTRIBUTION OF TERMS OF ORDER e^2G TO THE ANOMALOUS MAGNETIC MOMENT OF THE MUON. Geshkenbein, B. V.; Ioffe, B. L. JETP Lett. (USSR) (Engl. Transl.); 11: 204-6(20 Mar 1970).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 11: 309-12(20 Mar 1970).

The contribution of terms of order e^2G, which contain quadratic divergences, to the muon anomalous magnetic moment is estimated. It is found that value of the quantity $(g-2)/2$ for the muon is smaller by two orders of magnitude than the experimental accuracy. (J.F.P.)

35627 SIMPLEST PROCESSES IN THE PAIR-CREATING ELECTRIC FIELD. Narozhnyi, N. B.; Nikishov, A. I. (Lebedev Inst. of Physics, Moscow). Yadern. Fiz.; 11: 1072-7(May 1970). (In Russian).

Probabilities of spinor and scalar pair production by the external field $\epsilon = E/ch^2k_0t$ are obtained. The particle scattering in such a field is considered and it is shown that an account of the particle identity (Fermi–Dirac or Bose–Einstein statistics) gives the correct results for the scattering: the total scattering probability equals to unity, that is, the Feynman theory has no Klein paradox. (Lebedev Inst. of Physics, Moscow)

35628 CALCULATION OF $\eta \to \mu^+ + \mu^-$ DECAY PROBABILITY. Litskevich, I. K. (Leningrad State Univ.). Yadern. Fiz.; 11: 1078-9(May 1970). (In Russian).

The relative probability of the electromagnetic decay $\eta \to \mu^+ + \mu^-$ is calculated by means of the method developed previously. As a result: $r' \equiv W_{\eta\to\mu^+\mu^-}/W_{\eta\to 2\gamma} = 3.2 \cdot 10^{-5}$ is obtained. (Leningrad State Univ.)

35629 ELECTROMAGNETIC POTENTIAL OF AN ELECTRIC DIPOLE AND A MAGNETIC DIPOLE IN MOTION, IN THE FRAME-WORK OF SPECIAL RELATIVITY. Poincelot, Paul (Centre National d'Etudes des Telecommunications, Issy-les-Moulineaux, France). Compt. Rend., Ser. B; 270: 1008-10(20 Apr 1970). (In French).

The equation giving the electromagnetic potential of an electric dipole and a magnetic dipole in motion is shown to be valid in the framework of special relativity. (France)

35630 DIFFRACTIVE $K\bar{K}$ PHOTOPRODUCTION IN A DUAL-RESONANCE APPROACH. Satz, H.; Schilling, K. (CERN, Geneva). Lett. Nuovo Cim.; 3: 723-7(6 Jun 1970).

The reaction $\gamma p \to K\bar{K}p$ is investigated in the framework of the dual-resonance model for diffraction dissociation. The cross section and the K^+K^- mass spectrum at 4 GeV/c were found to be in agreement with experiment. The proton–proton momentum transfer distribution for the φ band is shown together with the data for $\gamma p \to \varphi p$. The results are in good agreement with data. (L.B.S.)

35631 CONSEQUENCES OF EXCHANGE DEGENERACY IN COMPTON SCATTERING OF PIONS. Ahmad, M.; Fayyazuddin; Riazuddin (Univ. of Islamabad, Rawalpindi, Pakistan). Lett. Nuovo Cim.; 3: 719-22(6 Jun 1970).

The consequences of exchange degeneracy of the $\omega - A_2$ trajectories in the $\gamma + \pi^0 \to \gamma + \pi^0$ interaction are examined. The exchange degeneracy gives a relation between the residue functions of these trajectories by which the different possible mechanisms (Gell-Mann, Chew, etc.) can be discriminated. (L.B.S.)

35632 APPROXIMATE DENSITY-EFFECT CORRECTION FOR THE IONIZATION LOSS OF CHARGED PARTICLES. Armstrong, T. W.; Alsmiller, R. G. Jr. (Oak Ridge National Lab., Tenn.). Nucl. Instrum. Methods; 82: 289-90(1970).

An approximate density-effect correction for determining the stopping power and range of high-energy charged particles is discussed and evaluated. (auth)

35633 USE OF WEAK PARTIAL CONSERVATION OF AXIAL-VECTOR CURRENT TO RESOLVE THE $\eta \to 3\pi$ PUZZLE. Brandt, Richard A. (Rockefeller Univ., New York); Goldhaber, Michael H.; Preparata, Giuliano; Orzalesi, Claudio A. Phys. Rev. Lett.; 24: 1517-20(29 Jun 1970).

Current algebra and strong partial conservation of axial-vector current (PCAC) predict a good value for the slope of the decay $\eta \to \pi^+\pi^-\pi^0$ but also the (experimentally contradicted) approximate vanishing of the $\eta \to 3\pi$ rates. It is shown that weak PCAC provides a framework in which the good result remains valid, but the bad one does not. The only speculative step is the assignment of the most plausible quantum numbers of the H(990). (auth)

35634 RELATIVISTIC SPIN CORRECTIONS IN PROTON–PROTON BREMSSTRAHLUNG. McGuire, J. H. (Texas A and M Univ., College Station). Phys. Lett.; 32B: 73-4(8 Jun 1970).

Relativistic corrections to the $pp\gamma$ cross sections from the electromagnetic vertex are much smaller than experimental error if these corrections are calculated in the center of mass. In the lab frame they may be larger than experimental error. (auth)

35635 p–n AND $\pi^+ - \pi^0$ ELECTROMAGNETIC MASS DIFFERENCES IN NONLOCAL FIELD THEORY. Agnese, A.; La Camera, M.; Wataghin, A. (Univ., Genoa. Istituto Nazionale di Fisica Nucleare, Genoa). Nuovo Cim.; 68A: 80-8(1 Jul 1970).

A calculation of p–n and $\pi^+ - \pi^0$ electromagnetic mass differences was performed using form factors derived from a nonlocal field theory. This theory requires the introduction of a fundamental length ($l \approx 1/2m_p$) and of one timelike vector u(L) associated with a particular Lorentz frame (vertex frame). (auth)

Weak

Refer also to abstracts 35633, 35680, 35929, and 35930.

35636 (JINR-E2-5092) ATMOSPHERIC NEUTRINOS AND THE PROPERTIES OF THE NEUTRINO INTERACTIONS AT HIGH ENERGIES. Kunszt, Z.; Vesztergombi, G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1970. 10p. Dep. CFSTI (U. S. Sales Only).

Assuming that the intermediate vector boson exists, the structure functions in the deep inelastic νN scattering exhibit scale invariant behavior and that the weak interactions can be calculated as first order perturbation up to $10^3 - 10^6$ GeV in the ν energies, the ν_μ-induced muon-flux is estimated numerically. With a dip in the energy greater than 0.8 in the total cross sections, contradiction with the experimental muon-flux obtained in cosmic ray measurements is obtained. The scale invariance of the νW_2, MW_1 structure functions restricts the mean fractional energy transferred to prompt muons produced in the inelastic reactions in the interval $0.56 \leq k_\mu < 1$. (auth)

35637 (UJV-2400-F) SEMILEPTONIC DECAYS OF HYPERONS. Dittrich, J.; Janouch, F. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). 1970. 29p. Dep. CFSTI (U. S. Sales Only).

The semileptonic weak decay of polarized hyperons is investigated. The decay probability and correlations between momenta and spins of participating particles are calculated, relativistically. (auth)

35638 COMMENTS ON THE CURRENT-ALGEBRA DERIVATION OF THE $\Delta I = \frac{1}{2}$ RULE IN NONLEPTONIC K DECAY. Holstein, Barry R. (Princeton Univ., N. J.). Phys. Rev., D; 1: 1509-11(1 Mar 1970).

It is shown that the conventional current-algebra derivation of the $\Delta I = \frac{1}{2}$ rule for nonleptonic K decay is invalid within the model of SU(3) × SU(3) symmetry-breaking given by Gell-Mann, Oakes, and Renner. A method for retaining a $\Delta I = \frac{1}{2}$ rule and this model without invoking either neutral currents or octet dominance is discussed. (auth)

35639 RENORMALIZABLE THEORY FOR THE WEAK INTERACTION. Larm, Allan Michael. Salt Lake City; Univ. of Utah (1969). 108p.

Thesis.

A renormalizable theory is derived for the weak interaction by having the weak interaction carried by a scalar boson as well as a vector boson. The addition of the scalar boson is shown to be both a necessary and a sufficient condition for renormalizability, provided the ratio of the masses of the vector and scalar bosons are equal to the ratio of their coupling constants. From the set of all possible Feynman diagrams for the self-energy corrections to the boson propagators, a tensor-integral equation is derived for the corrected propagator of the weak interaction, and the equation is shown to be satisfied for all orders to a very good approxima-

tion by a sum of propagators for a vector and a scalar boson involving renormalized masses and coupling constants. Because certain divergent terms cannot be eliminated by appealing to gauge invariance as in quantum electrodynamics, it is necessary to modify the cutoff terms for the weak interaction, and also assume a point interaction of four bosons. Because the imaginary corrections to the masses of the vector and scalar boson must be in the same ratio as their coupling constants, and it is necessary to calculate higher order terms to find the imaginary correction to the mass of the scalar boson, the mass and coupling constant of the scalar boson must be larger than those of the vector boson. (Diss. Abstr. Int., B)

35640 DESCRIPTION OF THE SPACE–TIME PICTURE OF PRODUCTION AND DECAY OF UNSTABLE PARTICLES. Terent'ev, M. V. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 11: 1099-1111(May 1970). (In Russian).

The problem of the space-time picture in reactions of production and following decay of resonances (of unstable particles) is studied in terms of the wave packets. As applications, the following problems are studied: nonexponential corrections to the unstable particle decay law, the appearance of the effects due to the dimensions of the wave packets in the interference picture of $K_2 \to 2\pi$ and $K_1 \to 2\pi$ decays, the description of decays of states with indefinite metrics. (auth)

35641 UPPER LIMIT FOR ELASTIC SCATTERING OF ELECTRON ANTINEUTRINOS BY ELECTRONS. Reines, Frederick; Gurr, Henry S. (Univ. of California, Irvine). Phys. Rev. Lett.; 24: 1448-52(22 Jun 1970).

A conservative upper limit of 4 times the prediction of V–A theory was determined for the process $\bar{\nu}_e + e^- \to \bar{\nu}_e + e^-$. The target detector used in a fission $\bar{\nu}_e$ flux of 2.8×10^{13} cm^{-2} sec^{-1} was a 7.84-kg plastic scintillator arrangement enclosed by 330 kg of NaI and a 2200-liter liquid detector, the latter two operated in anticoincidence with the plastic. (auth)

Strong (General)

Refer also to abstract 35692.

35642 CONSTRUCTION OF A SET OF SELF-CONSISTENT EQUATIONS FOR CALCULATING THE STRONGLY INTERACTING PARTICLES. Gary, Gilmer Allen. Athens, Ga.; Univ. of Georgia (1969). 204p.

Thesis.

After constructing a general procedure for successively continuing the invariant scattering amplitude into a region where the crossing relations give a dynamical equation, a calculation of the self-consistent iterative possibilities is carried out. The most general form of the modified Cheng representation is used for the partial-wave S-matrix which is checked out numerically for the rate of convergence against other Regge representations. A numerical bootstrapping calculation of the rho meson is carried out to show the possibilities of the equations derived. The width and mass obtained are 120 and 762 MeV, respectively, in agreement with the experimental values of 90 to 150 MeV and 764 ± 11 MeV. The set of equations derived appears to be feasible for the calculation of the strongly interacting particles, though a group of theoretical problems remain to be solved. (Diss. Abstr. Int., B)

35643 THREE-BODY VERTICES IN A QUARK MODEL. Chylek, Petr (Univ. of California, Riverside). Phys. Rev., D; 1: 1505-6(1 Mar 1970).

Using two general principles to define an allowed vertex, the numerical selection rule is derived which is equivalent to the general principles for any vertex containing less than 14 quarks and antiquarks. (auth)

35644 CHIRAL DYNAMICS WITHOUT A_1. Petito, Joseph Michael. New York; City Univ. of New York (1969). 75p.

Thesis.

The nonlinear realization method of Weinberg is used to construct a chiral invariant Lagrangian consisting of π,N,N*(1236) and ρ but not A_1. Chiral invariance can be, of course, maintained without invoking the A_1 meson. In view of the experimental status of A_1, it may be worthwhile studying such a model. The tree diagram technique is used, with an off mass-shell N* propagator, to calculate pion nucleon S wave scattering lengths, isobar production parameters and single pion photoproduction differential cross sections. A comparison with the current algebra method is made. (Disser. Abstr. Int., B)

35645 LIMIT OF CROSS SECTIONS AT INFINITE ENERGY. Cheng, Hung (Massachusetts Inst. of Tech., Cambridge); Wu, Tai Tsun. Contract AT(30-1)-4101. Phys. Rev. Lett.; 24: 1456-60(22 Jun 1970).

The following predictions are made at infinite energy: (1) σ_{tot} approaches infinity; (2) the ratio of the real part to the imaginary part of the forward elastic amplitude approaches zero; (3) σ_{el}/σ_{tot} approaches ½; (4) the width of diffraction peak approaches zero; its product with σ_{tot} is a constant. Theoretical evidence based on massive quantum electrodynamics as well as experimental evidence in support of these predictions, and a physical picture for high-energy scattering are given. (auth)

35646 POSSIBLE FAILURE OF THE POMERANCHUK THEOREM: SHRINKAGE OF THE FORWARD ELASTIC PEAK. Casella, R. C. (National Bureau of Standards, Washington, D. C.). Phys. Rev. Lett.; 24: 1463-6(22 Jun 1970).

Assuming constant but unequal asymptotic total cross sections $\sigma_x(\infty)$ leads to a $(\ln s)^2$ shrinkage of the forward elastic peak. Moreover, under rather general assumptions, $d\sigma^{el}/dt$ exhibits an infinitude of oscillations in t as $s \to \infty$, a result derived earlier by Finkelstein within the Regge-cut model. (auth)

35647 RENORMALIZED SELF-ENERGY OPERATOR IN THE DUAL-RESONANCE MODEL. Burnett, T. H.; Gross, D. J.; Neveu, A.; Scherk, J.; Schwarz, J. H. (Princeton Univ., N. J.). Contract AF49-(638)-1545. Phys. Lett.; 32B: 115-20(8 Jun 1970).

A divergent planar self-energy operator and a real dual counterterm operator that cancels the divergence are obtained. These operators can be used to calculate multiloop planar diagrams. (auth)

Strong (Baryon No. = 0)

Refer also to abstract 35701.

35648 SCALAR-MESON MASSES IN THE VENEZIANO MODEL. Greenberg, David F. (Carnegie-Mellon Univ., Pittsburgh). Phys. Rev., D; 1: 1492-3(1 Mar 1970).

It is pointed out that formulas given by Arnowitt, Nath, Srivastava, and Friedman for masses of scalar mesons in the Veneziano model are incorrect; new formulas for these mesons are derived and compared with experiment. (auth)

35649 EXTRAPOLATION MODEL FOR $\pi\pi$ SCATTERING. Williams, P. K. (Florida State Univ., Tallahassee). Phys. Rev., D; 1: 1312-18(1 Mar 1970).

A model is constructed as an alternative to, and for examination of, various extrapolation procedures used in determinations of $\pi\pi$ phase shifts from the reaction $\pi + N \to \pi + \pi + N$. This model is similar to that suggested by Ross and Kane in that it incorporates absorption effects approximately. (auth)

35650 CORRELATIONS IN BOSON PRODUCTION OF HIGH MULTIPLICITY. Pentz, Norman Edward. Cleveland; Case Western Reserve Univ. (1968). 115p.

Thesis.

Correlations in boson systems of high multiplicity are investigated. Such correlations depend upon the phase relations in the system which in turn depend upon the explicit state of the system. Attention is focused on the particular problem of the influence of isotopic spin conservation on angular correlations in a system of pions resulting from $\bar{p}$-p annihilation. The explicit state of this system is defined by the conservation laws in effect under that production interaction. The correlations are expressible, in the second quantized formulation, in terms of the expectation values of constrained pair operators in the state of the system. In order to evaluate such quantities in isotopic spin eigenstates of high multiplicity a projection operator and trace technique is developed to make such evaluations feasible. The method is first applied to a one-dimensional situation called the "two mode" model which lacks confinement but contains momentum and isotopic spin conservation. The resulting correlations are expressed in terms of the distributions of charged pion pairs among the two modes. The method is then applied to the realistic three-dimensional situation called the "continuous field" model. For this the statistical model assumptions of initial equilibrium and initial confinement are made. The correlations are considered to be characteristic of the phase relations established in the initial state of the system which is symmetrized in accordance with isotopic spin conservation. A general discussion is given concerning correlations and their dependence upon confinement, phase relations, symmetrization, and momentum conservation. (Diss. Abstr. Int., B)

35651 THE $\nu-\nu$ INTERACTION. Bardin, D. Yu.; Bilenkii, S. M.; Pontecorvo, B. (Joint Inst. for Nuclear Research, Dubna, USSR). Phys. Lett.; 32B: 121-4(8 Jun 1970).

A new hypothetical interaction between neutrinos is considered. It is shown that even relatively strong $\nu_e - \nu_e$, $\nu_\mu - \nu_\mu$ and $\nu_e - \nu_\mu$ interactions are not in contradiction with existing data and upper limits for the corresponding interaction constant are obtained. New

experiments are suggested which might give information on $\nu-\nu$ interactions. (auth)

35652 BB REACTIONS: DUALITY AND FACTORIZATION. Kugler, M. (Weizmann Inst. of Science, Rehovot, Israel). Contract F-61052-68-C-0070. Phys. Lett.; 32B: 107-10(8 Jun 1970).

A solution to the baryon-antibaryon problem in duality is proposed. The solution is based on abandoning the factorization of Regge exchanges; it contains no exotic resonances but contradicts duality diagrams. The proposed solution agrees with experiment. (auth)

Strong (Baryon No. = 1)

Refer also to abstract 35610.

35653 (ITF-70-24) DUALITY AND THE TOTAL CROSS SECTIONS OF MESON-NUCLEON SCATTERING IN THE QUARK MODEL. Kobushkin, A. P. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1970. 8p. Dep. CFSTI (U. S. Sales Only).

The possibility of using dual diagrams for the problem of finding the relations between the total cross sections of meson-nucleon scattering is studied. It is shown that the duality, crossing symmetry and analyticity on s, t, u are in contradiction in this model. Eliminating the requirement of the crossing symmetry on $s \longrightarrow u$ of the scattering amplitude and preserving the duality and analyticity, one gets the relations between the total cross sections which are compared with experiment. (auth)

35654 CHIRAL-DYNAMICS CALCULATIONS OF SINGLE-PION PRODUCTION IN PION-NUCLEON INELASTIC SCATTERING. Long, W. F.; Kovacs, J. S. (Michigan State Univ., East Lansing). Phys. Rev., D; 1: 1333-40(1 Mar 1970).

Cross sections for pion production were calculated using several different chiral-dynamics Lagrangians including those of Schwinger and Weinberg. In order to compare the results with cross sections above threshold all tree diagrams were retained and integrations over final state variables were performed by a Monte Carlo method. A model in which the symmetry-breaking term transforms as a rank-2 chiral tensor was found to give the best fit to the total cross-section data for incident pion energies of less than 330 MeV, but none of the models gave good fits to the differential cross-section data. (auth)

35655 CONTINUOUS DISPERSION SUM RULE AND THE NAK COUPLING CONSTANT. Liu, Yu-Chien; McGee, Ian J. (Univ. of Waterloo, Ont.). Phys. Rev., D; 1: 1507-8(1 Mar 1970).

A continuous dispersion sum rule is used to estimate the NAK coupling constant. Together with the recent zero-range K-matrix parametrization of low-energy $\bar{K}N$ scattering, the sum rule yields $g^2_{\Lambda K} \simeq 6.9$ and gives excellent results for $\alpha_{K^+p} - \frac{1}{2}\alpha_{K^+n}$ ($\alpha_{K^+p} = \mathrm{Re}C_{K^+p}/\mathrm{Im}C_{K^+p}$) at high energy. Until the real part of the scattering amplitude is known more accurately in the intermediate region, the present calculation does not absolutely favor or disfavor the multiple-channel effective-range parametrization. (auth)

35656 GENERALIZED SUPERCONVERGENCE SUM RULES AND APPLICATIONS AND STRUCTURE OF WEAK INTERACTION AT HIGH ENERGY. Mohapatra, Rabindra Nath. Rochester, N. Y.; Univ. of Rochester (1969). 157p.

Thesis.

A new type of dispersion sum rule, known as continuous moment sum rule, is suggested. This sum rule relates the high energy behavior of an amplitude to low energy parameters. Therefore, a knowledge of the low energy total cross section enables one to obtain the value of the coupling strength of various Regge poles to the meson-nucleon systems. This was applied to the crossing symmetric πN and $\bar{K}N$ scattering, and values for $\sigma^{\pi^-p}_{tot}(\infty)$ and $\sigma^{K^-p}_{tot}(\infty)$ were obtained. The values obtained are quite close to experimental values. It is then suggested that the discrepancy is due to the existence of P' trajectory and the coupling strength of this trajectory to π- and K-nucleon system is evaluated. The procedure was repeated for the $\pi\pi$ scattering. If one approximates the low energy region by resonances, one gets a value for $\sigma^{\pi^+\pi^-}_{tot}(\infty)$, which does not agree with that obtained from factorization theorem. This seems to be in agreement with the conjecture of Harari, according to which Pomeranchuk has its origin in the nonresonating background of the scattering amplitude. The same technique was used to obtain a modified interference model for cases like $\pi^-p \rightarrow \pi^-p$ backward scattering and $\pi^-p \rightarrow \pi^0n$ scattering near forward direction, where single dominant Regge exchange is involved. This model does not suffer from the disease of double counting which the previously suggested ones do. This is then tested experimentally in the case of $\pi^-p \rightarrow \pi^0n$ scattering by calculating the differential cross section and polarization at laboratory energies of 5.9 BeV and 11.2 BeV. Good agreement is found. Also a relation is derived between the coupling of the Reggeized ρ-meson with πN system and the low energy resonances, which looks like a duality relation. However, it does not agree too well with experiment. The significance of this disagreement was discussed. The validity of the usual current-current and intermediate vector boson models of weak interaction at high energies is evaluated. Using the current commutation relations of Gell-Mann and the Bjorken technique to study the behavior of the scattering amplitude of weak currents on hadrons for large space-like momentum of the currents, it is shown that the higher weak processes are quadratically divergent even in the presence of strongly interacting particles. However, if one cuts off the higher order amplitudes at some value of energy, the process has a finite matrix element. Then using the experimental information on higher order weak processes like $K^+_L \rightarrow \mu^+\mu^-$ and $K^0_L - K^0_S$ mass difference, a value for the cutoff energy was obtained. The decay $K^0_L \rightarrow \mu^+\mu^-$ yields a value of the cutoff around 35 to 100 BeV, depending on the current-current and IVB model. Making some plausible approximations in the case of the neutral kaon mass difference, a cutoff around 4 BeV was obtained. These calculations lead one to suggest that, above an energy of 4 BeV, the weak interaction becomes nonlocal. Although the precise reason as to why it does so is not clear, it is suggested that this could be due to the strong interaction of the intermediate vector bosons if they exist. In any case, if the cutoff is as low as is suggested above, then one can accept the perturbation theoretic calculation of S-matrix for the weak processes because the higher order corrections are, in that case, small and one gets a theory of weak interaction that makes sense to all order in the weak coupling constant. In the last chapter, some recent attempts to obtain a finite theory of weak interaction are summarized and their merits and demerits are discussed. (Diss. Abstr. Int., B)

35657 COHERENT PHOTO PRODUCTION OF RHO MESONS. Margolis, B. (McGill Univ., Montreal). Can. Res. Develop.; 3: 26-30(May-Jun 1970).

Study of the response of strongly interacting elementary particles (hadrons) to photons is a field that has received much attention in the past few years. A proper theory of the nature and interaction of these particles should bring with it an understanding of their electromagnetic properties and hence of their interaction with photons. Conversely, one can expect that by studying the interaction of photons and electrons or muons (which can emit virtual photons) with hadrons one can learn much about the hadronic world. (auth)

35658 CURRENT ALGEBRA AND NUCLEON VERTEX FUNCTIONS. Radutskii, G. M.; Tabachenko, A. N. (Inst. of Nuclear Physics, Electronics, and Automation, Tomsk, USSR). Yadern. Fiz.; 11: 1087-9(May 1970). (In Russian).

The Lagrangian of interaction of nucleons with π, ρ and A_1 mesons is constructed with restrictions on the coupling constants following from the hypothesis of the vector current conservation, partial axial current conservation, one-particle dominance and current algebra SU(2) × SU(2) in the "hard" pion approximation. As a result all the nucleon vertex functions are expressed through three unknown parameters. In particular, the form factors of the vector and axial-vector current are in good agreement with the experimental data at low energies. (auth)

35659 VECTOR DOMINANCE, CURRENT CONSERVATION, AND $\pi N \rightarrow \rho N$ REACTION AT HIGH ENERGIES. Achasov, N. N.; Shestakov, G. N. (Inst. of Mathematics, Moscow). Yadern. Fiz.; 11: 1090-8(May 1970). (In Russian).

A model of the pole vector meson dominance is formulated for invariant amplitudes. It is shown that assuming independence of the invariant amplitudes on the vector meson mass and with current conservation one obtains relations for the t-channel helicity amplitudes. These relations are considered for the $\pi N \rightarrow \rho N$ reaction in various Regge models. In the model of π, ω and A_2 Regge poles one gets relations to the density matrix elements that may be tested in experiment. For the $\pi^-p \rightarrow \rho^-p$ reaction at 8 GeV/c agreement with the experiment is reasonable at not too small $|t|$. (auth)

35660 IMPLICATIONS OF LOCAL DUALITY IN MESON-DECUPLET SCATTERING. King, M. J.; Wali, Kameshwar C. (Syracuse Univ., N. Y.). Phys. Rev. Lett.; 24: 1460-3(22 Jun 1970).

The consequences of the assumption that the imaginary parts of the direct-channel helicity amplitudes vanish in the forward (backward) scattering if the crossed t channel (u channel) is exotic are examined in the case of meson-decuplet scattering. Within a limited energy region above the threshold, it is shown that the solutions of the set of equations provided by different external helicities predict the existence of certain patterns of octet and

decuplet baryons degenerate in mass and having spin and parity assignments $\frac{3}{2}^+$, $\frac{3}{2}^+$, $\frac{1}{2}^+$. (auth)

35661 STRONG-CUT REGGEIZED ABSORPTION MODEL FOR BACKWARD SCATTERING. Kelly, R. L.; Kane, G. L.; Henyey, F. (Univ. of Michigan, Ann Arbor). Phys. Rev. Lett.; 24: 1511-16(29 Jun 1970).

The combined data for the high-energy backward reactions $\pi N \rightarrow N\pi$, $\pi N \rightarrow N\rho$, and $\gamma N \rightarrow N\pi$ are analyzed in terms of the strong-cut Reggeized absorption model proposed by Henyey, Kane, Pumplin, and Ross. Only the N and Δ trajectories and the associated Regge cuts are necessary to describe the data, including the dip structure. The analysis lends strong support to the model, in particular to the feature that the Regge pole amplitudes do not have zeros at nonsense wrong-signature points. (auth)

35662 DIP STRUCTURE MECHANISM AND RATIO OF π^0 PHOTOPRODUCTION ON PROTON AND NEUTRON. Tran Thanh Van, J. (Laboratoire de Physique Theorique et Hautes Energies, Orsay, France). Lett. Nuovo Cim.; 3: 678-83(30 May 1970).

It is shown that the experimental dip structures can be predicted in the framework of the conventional Regge-pole absorption theory for the following interactions: $\pi^- p \rightarrow \pi^0 n$, $\pi N \rightarrow \pi\Delta$, $\pi^0 p \rightarrow \omega p$, $\pi N \rightarrow \omega N$, $\pi N \rightarrow \omega\Delta$, $\gamma p \rightarrow \pi^0 p$, $\gamma p \rightarrow \eta p$, and $\gamma N \rightarrow \pi^+(\pi^-)N$. The theory also predicts the dip structure in the ratio of π^0 photoproduction on neutrons and protons. It is shown that the absence of a dip in some reactions, especially in $\pi N \rightarrow \omega N$ or $\omega\Delta$, is due to the contribution from strong B-meson exchange. (L.B.S.)

35663 REGGE POLES WITH KINEMATIC CUTS IN π N BACKWARD SCATTERING. Halzen, F.; Kumar, A.; Martin, A. D.; Michael, C. (CERN, Geneva). Phys. Lett.; 32B: 111-14(8 Jun 1970).

The effects of including kinematic cuts to suppress parity doublets in the Regge pole description of πN backward scattering are investigated. (auth)

Strong (Baryon No. ≥ 2)

Refer also to abstract 35927.

35664 (JINR-P2-5078) DOUBLE SCATTERING IN THE PROCESSES OF QUASI-ELASTIC INTERACTION OF π MESONS WITH DEUTERONS. Tarasov, A. V.; Tseren, Ch. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1970. 14p. (In Russian). Dep. CFSTI (U.S.Sales Only).

The contribution of the double scattering amplitudes to the cross section of quasi-elastic scattering of π-mesons by deuterons and the cross section of charge exchange of π-mesons by deuterons in the mean energy region is investigated. (auth)

35665 INTERPRETATION AND EVALUATION OF THE TWO-TEMPERATURE MODEL OF HIGH-ENERGY INTERACTIONS. Zgrablich, G. (Argonne National Lab., Ill.); Wayland, J. R. Phys. Rev., D; 1: 1501-5(1 Mar 1970).

The physical interpretation and evaluation of the two-temperature statistical model for particle spectra in proton-proton collisions is considered. It is shown that the longitudinal temperature can be considered as a kinematic property of the interaction process as described by a single-temperature momentum distribution in the rest frame of the fireball that results from the collision of the incident particle. The two-peaked angular distribution (in log $\tan\frac{1}{2}\theta^*$) of the produced particles is a pronounced feature of the two-temperature model, which is a one-fireball model. The pion inelasticity distribution is calculated and shown to agree with experiment. (auth)

35666 STRONG PION-ALPHA-PARTICLE SCATTERING WITH ELECTROMAGNETIC CORRECTIONS. Christensen, Ronald A. (Univ. of California, Berkeley). Phys. Rev., D; 1: 1469-91(1 Mar 1970).

Electromagnetic corrections to $\pi\alpha$ scattering for spacelike q^2 are calculated to see whether they can be used to determine r_π. The low-momentum t dependence of the off-shell strong amplitude used in this calculation is determined with the help of crossing symmetry, current algebra, and the hypothesis of partially conserved axial-vector current. The relativistic corrections are found to be just as important as those which are also included in nonrelativistic treatments. When only the nonrelativistic terms are used, the large value of r_π (2-3 F) obtained recently from $\pi^4\alpha$ scattering is reproduced. Including the relativistic terms brings the resulting value of r_π down to approximately 1 F. This is consistent with the values obtained by using inelastic electron-proton scattering; however, the $\pi^4\alpha$ results are quite sensitive to the details of the $\pi\alpha$ nuclear interaction and to the relativistic effects, which are only roughly approximated. (auth)

35667 SIMPLE VENEZIANO MODEL FOR np CHARGE-EXCHANGE SCATTERING. Pal, B. K. (Univ. of California, Riverside). Phys. Rev., D; 1: 1405-8(1 Mar 1970).

The np → pn amplitudes are written in simple Veneziano form. Only an M = 0 pion pole and an M = 1 pion parity doublet with corresponding exchange-degenerate B are considered to give rise to a sharp peak in dσ/dt at t = 0, giving qualitative agreement with experimental data. (auth)

35668 DYNAMICS FROM SYMMETRIES IMPOSED ON TWO-PARTICLE SYSTEMS. Smith II, Granville Jesse. Iowa City, Iowa; Univ. of Iowa (1969). 90p.
Thesis.

From the assumption that the S operator transforms as an irreducible tensor operator under an approximate symmetry group, called a two-particle symmetry group, it is shown that partial wave scattering amplitudes can be calculated. Two models, based on different two-particle symmetry groups, are presented. Investigation of the first model makes it clear that an energy-dependent amplitude can be calculated, but the amplitude cannot be identified as a unique partial wave amplitude. This problem suggests the investigation of the second model which is used, then, to calculate S-wave proton–proton elastic scattering phase shifts. Further research along these lines is suggested. (Diss. Abstr.)

35669 RESULTS OF CASCADE CALCULATIONS OF PION–NUCLEUS INTERACTIONS AT 50 GeV. Artykov, I. Z.; Barashenkov, V. S. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 11: 1070-1(May 1970). (In Russian).

Results of cascade calculations with account of many-particle interactions are presented. Comparison of these results with the data obtained when treating the nuclear emulsion exposed to the beam from the Serpukhov machine will enable one to find out to what extent the cascade model is valid at energies T > 10 GeV. (auth)

35670 HADRON–NUCLEUS TOTAL CROSS SECTIONS. Franco, Victor (Brooklyn Coll., N. Y.). Phys. Rev. Lett.; 24: 1452-5(22 Jun 1970).

Total cross sections for collisions between high-energy hadrons and nuclei are calculated using both Woods-Saxon and Gaussian density distributions for the nuclei. Comparisons with measurements are made. Errors incurred by truncating multiple-scattering series are investigated. (auth)

Particle Invariance Principles and Symmetries

General

35671 INTERNAL SYMMETRY CANNOT BE CONCEALED. Kantor, Paul B. (Case Western Reserve Univ., Cleveland). J. Math. Phys. (N. Y.); 11: 1995-6(Jun 1970).

The problem is considered of determining whether a given "particle" is elementary or is some member of a degenerate multiplet corresponding to an exact symmetry. A double-scattering experiment is discussed which can make this determination unless the members of the multiplet are unable to distinguish one another. Finally, such an inability is shown to be incompatible with the usual relation between spin and statistics and known analyticity properties of scattering amplitudes for strongly interacting particles. (auth)

35672 PARTIAL CONSERVATION OF AXIAL CURRENT, AND PROCESSES WITH SOFT π-MESONS. Vainshtein, A. I.; Zakharov, V. I. Usp. Fiz. Nauk; 100: 225-76(Feb 1970). (In Russian).

Since isotopic symmetry explains all the experimentally known agreements of particle masses within the limits of a few million electron volts, it is clear that strong interactions do not have a symmetry greater than isotopic symmetry. The isotopic invariance is not strict with the ratio of the mass difference to the characteristic mass of the strong interaction equal to a value of $\frac{1}{100}$ to $\frac{1}{1000}$. However the existence of additional, approximate symmetries may be possible with an invariance violation on the order of $\frac{1}{10}$ so that the mass splitting within a multiplet may be on the order of 100 MeV. Much attention has been devoted to a search of this type of symmetry. Assumptions are made about the invariance of the strong interaction Hamiltonian with respect to conversions interchanging states with different parities, about axial currents of strong interactions with SU(2) × SU(2) symmetry coinciding with axial currents of weak interactions of hadrons and leptons without

a change in strangeness, and about "semi-strong" interactions which are responsible for the mass of the π-meson different from zero. The review covers the partial conservation of axial current, the violation of SU(2) × SU(2) symmetry, the Adler relation for neutrino reactions, μ-capture by a proton, strong processes with the participation of π-mesons, πN-scattering at low energies, π-π scattering, photo- and electro-generation of π-mesons, leptonic decays of K-mesons, nonleptonic decays of K-mesons and hyperons, and the effective Lagrangian of πN and π-π interactions. This comparison of theoretical relations with experimental data shows good agreement in a number of cases. (TTT)

35673 INFINITE-DIMENSIONAL REPRESENTATIONS OF THE LORENTZ GROUP. Carmeli, Moshe (Aerospace Research Labs., Wright-Patterson AFB, Ohio). J. Math. Phys. (N. Y.); 11: 1917-18(Jun 1970).

The method used by Naimark to obtain symmetrical spinors and their transformation law from finite-dimensional representations of the group SL(2,C) is extended to infinite-dimensional representations. As an infinite-dimensional representation, the principal series of representations realized by means of the special unitary group SU_2 is used. As a result another form of the principal series of representations of SL(2,C) is obtained which describes the transformation law of an infinite set of numbers under the group transformation in a way which is very similar, but as a generalization, to the way spinors appear in the finite-dimensional case. (auth)

35674 DEGENERACY OF THE SU(3) DIRECT PRODUCT AND THE SYMMETRIC REPRESENTATIONS OF SU(6) ⊃ SU(3) ⊗ SU(2). Resnikoff, M. (State Univ. of New York, Buffalo). J. Math. Phys. (N. Y.); 11: 1885-93(Jun 1970).

The relation between a state of U(n) associated with an m-rowed Young diagram, m ≤ n, and a state of U(m) associated with an m-rowed Young diagram provides the basis for the symmetric state of U(mm) ⊃ U(m) ⊗ U(n). As an application, the state vectors associated with the irreducible representations of SU(6) restricted to the subgroup SU(3) ⊗ SU(2) are explicitly constructed for the symmetric representation, and generalized to the case of a 2-rowed Young diagram. Expressions are given for the degeneracy of an SU(3) ⊗ SU(2) state in SU(6), and the completeness of the obtained set of states is discussed. The direct product of symmetric SU(6) ⊃ SU(3) ⊗ SU(2) states implies a direct product of SU(3) states; the operator which breaks the degeneracy of the "2-rowed" SU(6) ⊃ SU(3) ⊗ SU(2) state is shown to be Moshinsky's operator X which breaks the degeneracy of the SU(3) direct product. (auth)

35675 SPECTRUM OF CASIMIR INVARIANTS FOR THE SIMPLE CLASSICAL LIE GROUPS. Gilmore, Robert (Massachusetts Inst. of Tech., Cambridge). J. Math. Phys. (N. Y.); 11: 1855-6(Jun 1970).

The spectra of the Casimir invariants for the classical compact simple Lie groups are presented. It is proved that these invariants are irreducible and functionally independent. The highest weight of a representation is determined in terms of its invariant spectrum. (auth)

35676 INTERPRETATION OF THE SYMMETRY OF THE CLEBSCH–GORDAN COEFFICIENTS DISCOVERED BY REGGE. Bincer, Adam M. (Univ. of Wisconsin, Madison). J. Math. Phys. (N. Y.); 11: 1835-44(Jun 1970).

An interpretation is proposed for the intriguing symmetry of the Clebsch–Gordan coefficients discovered in 1958 by Regge. The interpretation is based on the observation that, in the reduction of the Kronecker product of two irreducible representations of an SU(2) group, there appears in a natural way another SU(2) group, which is almost independent of the original one. The Regge symmetry is interpreted as the symmetry under the interchange of these two SU(2) groups. In more picturesque language, the Regge symmetry is the symmetry under the interchange of the "two-ness" of the two angular momenta being added with the "two-ness" of SU(2). It follows from this interpretation that a symmetry of the same nature is present in the generalized Clebsch–Gordan coefficient that appears in the reduction of the Kronecker product of n (and not two, except when n = 2) irreducible representations of SU(n). (auth)

35677 BRANCHING RULES FOR REPRESENTATIONS OF A_n, B_n, C_n, AND D_n. Devi, V. Syamala (Andhra Univ., Waltair, India). Nuovo Cim.; 68A: 1-5(1 Jul 1970).

The "new multiplication" ⊛ of the characters of the full linear, orthogonal and symplectic groups, has been defined long ago in the context of finding the linearly independent concomitants of a given ground form. It is shown that evaluation of these ⊛ products determines the branching rules for a given Lie algebra of type A_n or B_n or C_n or D_n with respect to a subalgebra which may again be any one of these types, when the embedding of the subalgebra is in any possible manner. Further, the global technique helps in deriving general formulas for the branching rules. (auth)

Applications (Electromagnetic and Weak)

35678 NUCLEAR EXPERIMENT TO TEST OAKES'S THEORY. Chand, Prakash (Colorado State Univ., Fort Collins). Phys. Rev., D; 1: 1513(1 Mar 1970).

It is shown that by bombarding a Li nucleus by neutrinos coming out of kaon decay, directional photons may be observed if Oakes's theory of CP nonconservation is correct. (auth)

35679 SU(3) MODEL OF CP VIOLATION. Tribble, David Bradford. St. Louis: St. Louis Univ. (1969). 147p. Thesis.

The decays of the pseudoscalar mesons are studied within the framework of unitary symmetry and the current-current hypothesis of weak interactions. Octets of vector and axial-vector weak mesonic currents are defined in terms of the Kemmer field or relativistic SU(6). Lagrangians constructed by the coupling of currents are assumed to conserve CP as well as strangeness in a Cabibbo frame. In order to introduce the observed violation of CP-invariance in the nonleptonic decays of the K-mesons, Cabibbo's transformation is extended by including F_6 as well as F_7 rotation. The coupling of the vector and axial-vector parts of the weak mesonic current with the lepton current yield rates of decay which are independent of the F_6 rotation. Thus, Lagrangians for the leptonic and semi-leptonic decays of the pseudoscalar mesons reproduce the results of Cabibbo. An octet dominant Lagrangian is assumed for the nonleptonic decays. The $\Delta I = 1/2$ contribution arises from the mixing of a 27-plet component. Lagrangians formed in this manner yield the desired CP-violation in the 2π decays of the neutral K-mesons. The predicted result $|\eta_{+-}| = |\eta_{00}|$ is equivalent to the result of the super-weak theory. The possibility of direct $\Delta S = 2$ transitions in the neutral kaon system is considered. It is shown that self-coupling of the axial-vector part of the weak mesonic current yields contributions to such transitions via a 27-plet component. A model of CP-violation is then constructed on the basis of direct $\Delta S = 2$ transitions. The CP-violating effect of the F_6 rotation is restricted to the 27-plet contribution to the $K \to 2\pi$ Lagrangian. The 27-plet mixing parameter is phenomenologically fitted with the observed value for the ratio of rates $\Gamma(K_L \to \pi^+\pi^-)/\Gamma(K^+ \to \pi^+\pi^0)$. The amount of F_6 rotation is adjusted to provide a good fit to the experimentally measured $|\eta_{+-}|$. The model then predicts $|\Gamma(K_L \to \pi^+\pi^-)/\Gamma(K_S \to \pi^0\pi^0) = 2.397$; $\Gamma(K_L \to \pi^+\pi^-)/\Gamma(K_L \to \pi^0\pi^0) = 1.978|$ and $|\eta_{00}| = (2.19) \times 10^{-3}$ in agreement with experiment. However, the model is incapable of explaining the smallness of the $K_L - K_S$ mass difference. (Diss. Abstr. Int., B)

35680 CHIRAL $SU_3 \otimes SU_3$ GAUGE-INVARIANT DYNAMICS AND THE K_{l4} DECAY FORM FACTORS. Biswas, S. N. (Univ. of Delhi); Dutt, R.; Nanda, P.; Pandit, L. K. Phys. Rev., D; 1: 1445-50(1 Mar 1970).

A nonlinear chiral $SU_3 \otimes SU_3$ gauge-invariant phenomenological Lagrangian with the symmetry breaking through mass terms was constructed. The model is then employed to study the dynamical structures of the K_{l4} decay axial-vector form factors. The predicted decay rates are found to be in good agreement with experiments as well as with other calculations based on current algebra and dispersion theory. (auth)

35681 T-ODD CORRELATION IN $\Sigma^0 \to \Lambda e^+e^-$ DECAY DUE TO FINAL STATE INTERACTION. Kondratyuk, L. A.; Kopeliovich, V. B. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 11: 1080-6(May 1970). (In Russian).

The T-odd correlation is calculated in $\Sigma^0 \to \Lambda e^+e^-$ decay between the polarization vector of $\Lambda(\Sigma)$ hyperon and the normal to the decay plane, which is due to the final state interaction. The hyperon polarization due to this correlation is $\sim 10^{-4}$ while the experimental limit for it is $\sim 10^{-2}$. Measurement of the correlation in view may be in principle used for a determination of the magnetic moment of the Σ^0 hyperon. (auth)

35682 TIME REVERSAL AND RECIPROCITY IN DIRECT REACTIONS. Huffman, Arthur H. (Univ. of Washington, Seattle). Contract AT(45-1)-1388. Phys. Rev., D; 1: 890-902(1 Feb 1970).

Direct-reaction reciprocity tests of time-reversal invariance are analyzed on general grounds and specifically with the T-violating force derived in a preceding paper. A simple proof of Robson's theorem that a cutoff distorted wave Born approximation satisfies reciprocity irrespective of T violation is indicated. Numerical calculations are described which show that Robson's theorem is not a severe restriction on direct-reaction reciprocity tests, and that the violation of reciprocity is of the same order of magnitude as the ratio of the T-odd to T-normal forces. If the T-

violating term of the nucleon current contains an isovector part, the T-odd potential derived in the preceding paper implies roughly 0.2% violation of reciprocity in deuteron stripping. However, if the basic T violation is isoscalar, the violation of reciprocity will be reduced by a factor of 50 in the context of the model considered. (auth)

35683 VECTOR DOMINANCE, SU(6)-SYMMETRY AND WEAK $B \to B'\gamma$ DECAYS. Kulish, Yu. V. (Kharkov Inst. of Physics and Tech.). Ukr. Fiz. Zh.; 15: 558-62(Apr 1970). (In Russian).

It is shown that within the framework of the vector dominance model and SU(6)-symmetry the amplitudes of weak radiative decays with nonconservation of parity are equal to zero. The probabilities of decays $\Lambda \to n\gamma$, $\Sigma^+ \to p\gamma$, $\Xi^0 \to \Lambda\gamma$, $\Xi^- \to \Sigma\text{-}\gamma$ are calculated. The calculated probability of decay $\Sigma^+ \to p\gamma$ is in agreement with the experiment. (auth)

Applications (Strong)

Refer also to abstract 35701.

35684 (JINR-P1-5056) CHECKING T-INVARIANCE IN N–N SCATTERING (REVIEW). Zul'karneev, R. Ya. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1970. 28p. (In Russian). Dep. CFSTI (U. S. Sales Only).

The results of the investigation of T-invariance in N–N interaction are reviewed. Possible ways of checking T-invariance are considered. All the known experimental results are listed and their critical analysis is performed. The value of $\sin\lambda_2$, averaged in the region of 95-635 MeV, is given to be -0.012 ± 0.019 with the possible systematic error of measurements about 0.040. A necessity (and possibility) of a more precise definition (by an order) of experimental data is pointed out. (auth)

35685 GENERALIZED GROUP-THEORETICAL ANALYSIS OF SPONTANEOUS SYMMETRY BREAKING. Chan, Choi-lai (Univ. of Hong Kong). J. Math. Phys. (N. Y.); 11: 1815-24 (Jun 1970).

A group-theoretical analysis of spontaneous symmetry breaking is carried out in an extension of Glashow's work. A general theorem is proved which is then used to give several interesting results. Apart from a rederivation of Glashow's result, one can show, among other things, the following: if a hadronic triplet exists in nature which is nontrivially coupled to the rest of the hadrons, then octet enhancement immediately follows independently of any dynamical detail; in models containing the vector nonet, ϕ–ω mixing can, in principle, occur as a particular form of spontaneous symmetry breaking in the octet pattern; and if octet enhancement holds, the very accurate mass formula $m_\phi^2 + m_\omega^2 = 2m_K^2$ is established without recourse to any dynamical detail. Under the same general assumption, a further relation is found relating the mass of the nonet with the mixing angle, which is $4m_K^2 - 3(\cos^2\theta m_\phi^2 + \sin^2\theta m_\omega^2) - m_\rho^2 = 0$. (auth)

35686 NUCLEON–NUCLEON T-VIOLATING FORCE FROM ELECTROMAGNETIC INTERACTION. Huffman, Arthur H. (Univ. of Washington, Seattle). Contract AT(45-1)-1388B. Phys. Rev., D; 1: 882-9(1 Feb 1970).

A T-violating nucleon–nucleon potential is calculated with a model in which the basic violation is in the electromagnetic interaction. The conditions of hermiticity and current conservation are applied to choose a T-violating matrix element of the nucleon electromagnetic current. Since current conservation requires that the T-violating term vanish on the mass shell, the longest-range force comes from diagrams corresponding to the exchange of one photon and one pion. In leading nonrelativistic order, there are three spin-dependent T-violating forces of range roughly equal to the Compton wavelength of the pion and of "strength" about 0.01% of the one-pion-exchange potential. (auth)

35687 NONLINEAR EFFECTS IN A SELF-CONSISTENT CALCULATION OF SU_3 SYMMETRY BREAKING IN STRONG INTERACTION COUPLING CONSTANTS AND DIRECT-CHANNEL REGGEIZATION OF STRONG INTERACTION SCATTERING AMPLITUDES. Creekmore, Stephen Paul. Pasadena, Calif.; California Inst. of Tech. (1969). 184p.

Thesis.

A self-consistent calculation of residue shifts is generalized from SU_3 symmetry, originally performed by Dashen, Dothan, Frautschi, and Sharp, to include the effects of nonlinear terms. Residue factorizability is used to transform an overdetermined set of equations into a variational problem, which is designed to take advantage of the redundancy of the mathematical system. The solution of this problem automatically satisfies the requirement of factorizability and comes close to satisfying all the original equations. Some consequences of direct-channel Regge poles are investigated, and the problem of relating Reggeized partial wave expansions made in different reaction channels is treated. An analytic method is introduced which can be used to determine the crossed-channel discontinuity for a large class of direct-channel Regge representations, and this method is applied to some specific representations. It is demonstrated that the multi-sheeted analytic structure of the Regge trajectory function can be used to resolve apparent difficulties arising from infinitely rising Regge trajectories. Also discussed are the implications of large collections of "daughter trajectories." Two things are of particular interest: first, the threshold behavior in direct and crossed channels; second, the potentialities of Reggeized representations in self-consistent calculations. A new representation is introduced which surpasses previous formulations in these two areas, automatically satisfying direct-channel threshold constraints while being capable of reproducing a reasonable crossed-channel discontinuity. A scalar model is investigated for low energies, and a relation is obtained between the mass of the lowest bound state and the slope of the Regge trajectory. (Diss. Abstr. Int., B)

Field Theories

General

35688 SOME CONSISTENCY AND HIGH ENERGY THEOREMS IN STOCHASTIC FIELD THEORY. Yodzis, Peter Paul Jr. University Park, N. Mex.; New Mexico State Univ. (1969). 87p.

Thesis.

Several exact results in Ingraham's "stochastic" field theory are obtained. These fall into two classes. The first class concerns certain consistency problems associated with theories involving currents. It is shown that the well known "Schwinger term" ambiguities of local field theory are absent from stochastic field theory, the equal time commutators of a stochastic current with the fields with which it interacts can be zero, the theorems of Coleman on current-generated broken symmetries hold only in part for stochastic currents. The second class is concerned with high energy behavior. A lemma on the high energy behavior of Fourier transforms of matrix elements of retarded products of stochastic operators is provided. This lemma is applied to total scattering cross sections, where it is shown that the leading term allowed by the lemma gives constant total cross sections at very high incident energies, in accord with experiment, nucleon electromagnetic form factors, where it is shown that the leading term allowed by the lemma yields the famous q^{-4} asymptotic behavior of the Sachs form factors. Indications are given of possible future work in this field. (Diss. Abstr. Int., B)

35689 INSTANTANEOUS INTERACTION RELATIVISTIC DYNAMICS FOR TWO PARTICLES IN ONE DIMENSION. Hill, Robert Nyden (Univ. of Delaware, Newark). J. Math. Phys. (N. Y.); 11: 1918-37(Jun 1970).

Differential conditions which guarantee the Lorentz invariance of instantaneous action-at-a-distance relativistic dynamics have been given by Currie and by Hill. The general solution of these conditions is obtained for the special case of two particles in one dimension. The resulting equations of motion are integrated to obtain the world lines. World-line invariance is explicitly demonstrated. The equations of motion are cast into Hamiltonian form with the transformations of the inhomogeneous Lorentz group canonical. The Hamiltonian formulation is made unique up to a canonical transformation for those forces which fall off faster than the inverse square of the interparticle separation by the demand of asymptotic reduction to free particle form. The special case of the inverse-square-law forces of electrodynamics is considered; the constant of the motion associated with Lorentz invariance is found to have an interaction piece which survives asymptotically as in the relativistic mechanics of Van Dam and Wigner. The Poisson bracket $[x_1, x_2]$ between the physical coordinates also has an interaction piece which survives asymptotically for electrodynamics. (auth)

35690 DIFFERENTIAL FORMS AND MAXWELL'S FIELDS: AN APPLICATION OF HARMONIC INTEGRALS. Ohkuro, Shigeru (Tohoku Univ., Sendai). J. Math. Phys. (N. Y.); 11: 2005-12(Jun 1970).

Maxwell's equations are derived under the assumption of 4-dimensionality of Euclidean space from a somewhat different definition of time from that considered by Einstein, using differential forms and de Rham's theorem in the theory of harmonic integrals. It is shown that the continuity equation of the current density is an elementary consequence of the Jordan–Brouwer theorem of topology under the requirement of integrability of the field. Matter appears as a singular point of the field, and introduces various kinds of "currents," in the sense of de Rham

and Kodaira, according to the topological character of the domain of integration of the field. These "currents" describe characters of the material, and are represented not by ordinary functions, but by generalized functions in the Schwartz sense. Examples of these "currents," such as electric and magnetic polarizations and the supercurrent, are given, and the origin of the fundamental difficulties with dimensions in the usual theory of electromagnetism is attributed to this fact. (auth)

35691 STUDY OF SOME HIGHER-DIMENSIONAL UNIFIED FIELD THEORIES. Miketinac, Milivoj Josip. Chapel Hill, N. C.; Univ. of North Carolina (1968). 71p.

Thesis.

The nine-dimensional unified field theory is considered as the basis for a possible unification of all the physical fields. The choice of five extra dimensions arises from the fact that it is possible to realize all irreducible representations of SU(3) in the space of tensor (or spinor) fields on the 5-sphere. It is shown that it is not possible to build a nine-dimensional universe consisting of the topological product of a space-time with positive curvature R and a 5-sphere of radius r such that the ratio (R/r) has one of the two physically acceptable values: ∞ or 10^{39}. The basic physical ideas of the unification such as the decomposition of the metric, the small disturbances and their physical meaning are illustrated on the example of the five-dimensional unified field theory. The scalar field, which arises naturally from the decomposition of the metric of the five-dimensional manifold, is also investigated. It is shown that its dynamics is such that the field can not be identified as the Dicke's scalar field. (Diss. Abstr. Int., B)

Quantum Field Theory

35692 (SLAC-PUB-737) BROKEN SCALE INVARIANCE AND ANOMALOUS DIMENSIONS. Wilson, Kenneth G. (Stanford Linear Accelerator Center, Calif. Cornell Univ., Ithaca, N. Y. Lab. of Nuclear Studies). May 1970. 21p. (CONF-700411-1). Dep. CFSTI.

From Midwest Theory Conference, Notre Dame, Ind.

Mack and Kastrup have proposed that broken scale invariance is a symmetry of strong interactions. There is evidence from the Thirring model and perturbation theory that the dimensions of fields defined by scale transformations will be changed by the interaction from their canonical values. These ideas and their consequences for strong interactions are reviewed. (auth)

35693 TOPICS IN APPLIED QUANTUM ELECTRODYNAMICS. Urban, Paul. Vienna; Springer-Verlag (1970). 274p. $15.85.

The lectures are divided into two parts: electron scattering and nucleon form factors, and radiative corrections. The first part deals with the following topics: Dirac–Foldy–Wouthuysen transformation; proton form factors derived from electron–proton scattering; neutron form factors derived from quasielastic electron–deuteron scattering; and nucleon form factors in dispersion theory. The second part deals with classical radiation of long-wavelength photons; summation over soft-photon contributions; radiative corrections in the framework of quantum electrodynamics; and examples of electron–proton and inelastic electron scattering. An appendix is also included, which deals with the Green functions of the Klein–Gordon and Dirac equations and the theory of bosons and fermions. (L.B.S.)

35694 BOUND STATE AND UNSTABLE PARTICLE SCATTERING IN MODEL QUANTUM FIELD THEORY. Liu, Tsu-huei. Eugene, Oreg.; Univ. of Oregon (1969). 276p.

Thesis.

The V-2θ sector and also the higher V-nθ sector with n > 2 of the Lee model are investigated. An iterative expansion technique is developed for solving the Green's functions in these sectors. The iterative expansion is constructed so that each term of the series preserves all the properties of the (Vθ) bound state, the analytic structure and the symmetries of the Green's function. The solutions of these Green's functions give all the bound state and nonbound state scattering amplitudes in these sectors. The investigation of the V-2θ sector also allows one to study the unstable composite state scattering. Two types of unstable particles are discussed: unstable elementary particles and unstable composite states. These unstable particles are illustrated by means of the Lee model and a modified form of it. The unstable particle is considered to be related to the complex pole of the analytically continued S-matrix. The mass and lifetime of the unstable elementary V particle in the modified Lee model and those of the unstable (Vθ) composite state are determined by the position of the complex pole. The different ways of calculating the renormalization constant for the unstable particle are discussed. An extension of the Lehmann–Symanzik–Zimmerman (LSZ) formalism is constructed to include the unstable elementary V particle. The formalism is exact and does not depend on the arbitrary separation of the total Hamiltonian as in perturbation theory. The asymptotic conditions are formulated for the unstable particles in terms of its complex mass. Also the analytical continuation of the decay and scattering matrix elements onto the unphysical Riemann sheet is investigated. The decay and scattering amplitudes for the unstable elementary V particle are calculated. Comparison with the results obtained by perturbation theory is discussed. The results agree with each other in the lowest order which is expected from the uncertainty principle. The unstable (Vθ) composite state in the Lee model serves as an excellent example for illustrating the extended LSZ formalism for unstable composite states. It is evident from the illustration that the extended LSZ formalism is independent of the types of the unstable particles. The decay amplitudes for the processes $(V\theta)_u \rightarrow V + \theta$; $(V\theta)_u \rightarrow N + \theta + \theta$ and the S-matrix for the process $(V\theta)_u + \theta \rightarrow (V\theta)_u + \theta$ are calculated. A very interesting result obtained in this work is that all the amplitudes for both stable and unstable particles are independent of the form of the interpolating fields. (Diss. Abstr. Int., B)

35695 CURRENT ALGEBRAS, THE SUGAWARA MODEL, AND DIFFERENTIAL GEOMETRY. Hermann, Robert (Rockefeller Univ., New York. Inst. for Advanced Study, Princeton, N. J.). J. Math. Phys. (N. Y.); 11: 1825-9(Jun 1970).

The Lie algebra defined by the currents in the Sugawara model is defined in a way that is natural from the point of view of Lie transformation theory and differential geometry. Previous remarks that the Sugawara model is associated with a field-theoretical dynamical system on a Lie group manifold are made more precise and presented in a differential geometric setting. (auth)

35696 MASSIVE VECTOR FIELD: COVARIANT DEFINITION OF INDEPENDENT COMPONENTS AND QUANTIZATION. Mathews, P. M. (International Centre for Theoretical Physics, Trieste, Italy). J. Math. Phys. (N. Y.); 11: 1997-9(Jun 1970).

A new approach to the theory of the vector field is presented in which inelegant features like negative terms in the energy do not make an appearance at any stage. All components of the field are handled in a completely symmetric fashion and the explicitly covariant appearance of the theory is preserved in the process of quantization as well as in earlier stages. Though the special features which arise when the mass vanishes are pointed out, a detailed treatment of that case is not included. (auth)

35697 KINETICS OF RADIATIVE POLARIZATION. Baier, V. N.; Katkov, V. M.; Strakhovenko, V. M. (Novosibirsk State Univ., USSR). Zh. Eksp. Teor. Fiz.; 58: 1695-1702(May 1970). (In Russian).

An equation describing the behavior of a spin in an external electromagnetic field is obtained in the quasiclassical approximation by taking into account radiation effects. Radiative polarization is investigated by means of the equation. (auth)

35698 QUANTUM THEORY OF THE GENERALIZED WAVE EQUATIONS. I. Tripathy, Kishor C. (Syracuse Univ., N. Y.). J. Math. Phys. (N. Y.); 11: 1901-12(Jun 1970).

A systematic analysis is made of the quantum theory of the infinite-component fields that transform under the combined representations of SL(2,C) (Majorana) ⊕ Dirac. A complete set of solutions of the wave equation includes solutions with timelike and spacelike momenta. The mass spectra for the timelike and spacelike cases were explicitly calculated. The method makes use of the decomposition of the product representation into reducible representations of the "little" groups SU(2) and SU(1,1). Finally, the quantization of the generalized fields is presented. (auth)

35699 TACHYON PHOTONS IN THE FRESNEL VANISHING WAVE. CONSERVATION OF MOMENTUM-ENERGY IN THE DIPOLAR EMISSION-ABSORPTION. Costa De Beauregard, Olivier (Institut Henri Poincare, Paris). Compt. Rend., Ser. B; 270: 1004-7(20 Apr 1970). (In French).

As a practical method of simultaneously detecting the absorption (or stimulated emission) of quanta of energy $\hbar\omega$ and momentum $\hbar k^x = n\alpha\hbar\omega/c > \hbar\omega/c$ associated with the Fresnel vanishing wave, dipolar transition on atoms or ions of velocity $(v^x, 0, 0)$, is proposed. (France)

35700 NONLINEAR GAUGE TRANSFORMATIONS. Gal-Ezer, E. (Tel-Aviv Univ., Israel). Lett. Nuovo Cim.; 3: 689-92(30 May 1970).

Weinberg's treatment of SU(2) × SU(2) nonlinear global transformations is extended to nonlinear transformations. (L.B.S.)

35701 SYMMETRY BREAKING IN LAGRANGIAN THEORIES OF CURRENT ALGEBRA. Gottlieb, H. P. W. (Cambridge Univ., Eng.). Lett. Nuovo Cim.; 3: 693-6(30 May 1970).

The standard procedure of obtaining realizations of current algebra from Lagrangians is to construct a symmetric Lagrangian and define currents by Noether's theorem; current commutation relations are realized by canonical field commutators. Symmetry breaking is customarily described by adding nonderivative terms. Extensions of the customary procedure are proposed to allow for a more general description of symmetry breaking by inclusion of certain derivative terms. The case of spinless bosons is considered. (L.B.S.)

35702 NONINTERACTION THEOREM FOR A CLASS OF BOSE FIELDS. Sinha, Kalyan Bidhan. Rochester, N. Y.; Univ. of Rochester (1969). 83p.

Thesis.

A non-interaction theorem is proven for a class of Bose fields in the usual Hamiltonian formalism in the case when the number of space dimensions is greater than or equal to 3. As a by-product, part of the canonical commutation relations (CCR) is derived in Heisenberg form. (Diss. Abstr. Int., B)

35703 CONFORMAL COVARIANCE OF EQUATIONS FOR PARTICLES OF SPIN j AND MASS 0. Bayen, F. (Institut Henri Poincare, Paris). Nuovo Cim.; 68A: 39-48(1 Jul 1970). (In French).

Conformal covariance of Dirac–Fierz equations for particles of spin j and mass zero is proved, the conformal degree of the field being j + I. The space-time dependent matrices used to transform the fields when a finite conformal transformation is performed are given and can be used to prove conformal covariance of other equations. (auth)

35704 ROLE OF POTENTIALS IN QUANTUM ELECTRODYNAMICS. Kreick, John Raymond. Ann Arbor, Mich.; Univ. of Michigan (1969). 61p.

Thesis.

The role of potentials in quantum electrodynamics and specifically with phenomena caused by the local effect of potentials themselves when the action of electric and magnetic fields is locally absent is considered. The case of an ideal point solenoid, or flux line, is treated. It is shown that there are no accessible fields for charged particles in this case and any effects seen must be due to local action of the potentials. A new representation of the exact wave function is found for electrons by use of an integral transform, and is used to show that scattering and first order radiative processes do exist. The rates for these processes are calculated exactly and comments made on the possibility of observing them experimentally. Since classical electrodynamics gives no radiation for this problem, this represents a quantum, but macroscopic, correction to classical theory. (Diss. Abstr. Int., B)

35705 RARITA–SCHWINGER FORMALISM FOR BOSON FIELDS. Nack, M. L. (Yeshiva Univ., New York). Nuovo Cim.; 68A: 89-104(1 Jul 1970).

A Rarita–Schwinger formalism is developed for general boson or tensor fields representing particles with both zero and nonzero masses. As examples of relativistic classical fields, the Proca and Maxwell fields are viewed from the two alternative approaches contained in this formalism; the first employing a rank-one tensor, and the second employing a rank-two antisymmetric tensor. Then the 4-vector field developed by Goldberg, Haller and Landovitz will be examined as a quantum field theory. (auth)

35706 REGGE FAMILIES IN THE WICK–CUTKOSKY MODEL. Gatto, R. (Univ., Padua. Istituto Nazionale di Fisica Nucleare, Padua); Menotti, P. Nuovo Cim.; 68A: 118-61(1 Jul 1970).

The bound solutions of the Wick–Cutkosky model are analytically continued to the whole complex l-plane by means of a method utilizing a Volterra integral equation equivalent to the Cutkosky differential equation. General results on the behavior of the Regge trajectories are derived. In particular it is proved that in the limit $\lambda \to 0$, where λ is the coupling strength, N Regge poles even in relative time and N−1 poles odd in relative time tend to the negative integer −N. Collision phenomena among the trajectories are proved to occur in the exact solution. Additional features relevant to the understanding of the behavior of the trajectories are derived. (auth)

Gravitation and General Relativity

35707 RELATIVISTIC GRAVITATIONAL EXPERIMENTS. Braginskii, V. B.; Rudenko, V. N. (Moscow State Univ.). Usp. Fiz. Nauk; 100: 395-424(Mar 1970). (In Russian).

A brief review is given of the experiments, projects, and experimental schemes carried out during the last five years. The review covers series of variations on gravitation theory, scalar-tensor Brans–Dicke theory, tensor gravitation theory in plane space, Jordan model with variable gravitation constant and others. 100 references are included. (R.V.J.)

35708 FREQUENCY SPECTRA OF GRAVITATIONAL WAVES IN THE UNIVERSE. Ezawa, Zyun F. (Tokyo Univ.). J. Phys. Soc. Jap.; 28: 1576-82(Jun 1970).

Estimations are given for frequency spectra of gravitational waves radiated from usual celestial phenomena. These analyses are intended to present the orientation to this problem by describing several typical examples. Next, possible sources for Weber's experiment are searched. It turns out that there are no possible candidates among usual astronomical events to account for that observation. A possibility is suggested based upon mass-exchange in a binary containing a neutron-star. (auth)

35709 CHARGE-DUST DISTRIBUTIONS IN GENERAL RELATIVITY. Raychaudhuri, A. K.; De, U. K. (Presidency Coll., Calcutta). J. Phys., A (London); 3: 263-9(May 1970).

Some simple theorems and relations for charged-dust distributions in general relativity are presented. (auth) (UK)

35710 TETRAD EQUATIONS FOR THE TWO-COMPONENT NEUTRINO FIELD IN GENERAL RELATIVITY. Griffiths, J. B.; Newing, R. A. (University Coll. of North Wales, Bangor). J. Phys., A (London); 3: 269-73(May 1970).

Weyl's neutrino equations were exhibited as equivalent tetrad equations, and the tetrad conditions for a pure radiation neutrino gravitational field were established. It was shown that the neutrino flux vector for the radiation field defines a shear-free and twist-free family of geodesics. A class of metrics was found which can be interpreted either as neutrino radiation or as null Einstein–Maxwell fields. (auth) (UK)

35711 ROTATING RING RESONATOR IN A GRAVITATIONAL FIELD. Volkov, A. M.; Kiselev, V. A. (Moscow Physical-Technical Inst.). Zh. Eksp. Teor. Fiz.; 58: 1857-61(May 1970). (In Russian).

The effect of a gravitational field on the eigenfrequencies of a rotating ring resonator is investigated on the basis of general relativity theory and electromagnetic theory for continuous media. The covariant equations of propagation of electromagnetic waves in a medium which is at rest in a rotating reference system in the presence of a gravitational field are written down in vector form. The equations are used for studying the resonance properties of a ring optical resonator. Formulas for the frequency shift of traveling waves and for the frequency difference of opposite waves in a resonator with a nonmutual element are derived for plane electromagnetic waves propagating in a rotating ring resonator. It is shown that for low resonator rotation velocities the frequency difference for opposite waves due to a static gravitational field is greater than the effect due to resonator rotation by several orders of magnitude. The effect of a stationary gravitational field created by a rotating mass on the eigenfrequencies of a ring resonator is also considered. (auth)

35712 MULTIPOLE MOMENTS. I. FLAT SPACE. Geroch, Robert (Syracuse Univ., N. Y.). J. Math. Phys. (N. Y.); 11: 1955-61(Jun 1970).

There is an intimate connection between multipole moments and the conformal group. While this connection is not emphasized in the usual formulation of moments, it provides the starting point for a consideration of multipole moments in curved space. As a preliminary step in defining multipole moments in general relativity (a program which will be carried out in a subsequent paper), the moments of a solution of Laplace's equation in flat 3-space are studied from the standpoint of the conformal group. The moments emerge as certain multilinear mappings on the space of conformal Killing vectors. These mappings are reexpressed as a collection of tensor fields, which then turn out to be conformal Killing tensors (first integrals of the equation for null geodesics). The standard properties of multipole moments are seen to arise naturally from the algebraic structure of the conformal group. (auth)

35713 TRIANGULAR LAGRANGIAN PROBLEM FOR ROTATING BODIES IN GENERAL RELATIVITY THEORY. Ryabushko, A. P.; Filipovich, K. S. (Belorussian State Univ., Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Mat. Navuk; No. 6, 94-102(1969). (In Russian).

In post-Newtonian integration the approximate equation for forward motion in the limited flat circular problem of three rotating bodies is given in the case, in which the triangular Lagrangian solution is taken in Newtonian theories. The obtained general solutions show that the motion of rotating bodies is unstable relative to the order of Newtonian magnitudes. New effects are discovered such as secular changes of orbital moments of momentum (which leads to the precessions of the planes for orbits of bodies), secular changes of the angle of rotation of the radius-vectors of bodies upon their motion relative to the orbit and other bodies.

The results obtained can be applied to celestial mechanics and to astrophysics. (tr-auth)

35714 LORENTZ ENSEMBLES IN STOCHASTIC THEORY OF SPACE-TIME. Lyles, Samuel Pickles Jr. Norman, Okla.; Univ. of Oklahoma (1969). 54p.

Thesis.

A stochastic theory of space-time is derived from consideration of coordinate and field measurements resulting from single acts of observation of the ensemble of all Lorentz observers. This is in contrast to the stochastic theory of R. L. Ingraham which proceeds from consideration of the repeated measurements of individual observers. The basic features of the two theories differ very little. Observer dependence of physical measurements, the basis of both theories, is shown to lead to a lower bound on coordinate measurements and the loss of general form invariance under tensor transformations. In addition, the new derivation shows that dispersion in spatial coordinates implies dispersion in the measurement of time, and conversely. It is perhaps significant that the new derivation makes use of only two assumptions: all observers have subjectively identical stochastic formalisms (principle of relativity), and all observers agree on the mean speed of light. It is demonstrated that one may construct a model satisfying the requirements of the theory by choosing the supports of space-like events to be certain space-like planes, the supports of time-like events to be certain time-lines, and the support of null events to be the light cone. With this choice, the distributions functions may be displayed explicitly as modified gaussian distributions. It is also found that this choice implies absolute agreement by all observers on the sharp speed of light. (Diss. Abstr. Int., B)

Scattering Theory

Refer also to abstract 35668.

35715 EXPANSION OF THE SCATTERING AMPLITUDE AT HIGH ENERGY. Kwok, P. Y.; Kiang, D. (Dalhousie Univ., Halifax, Nova Scotia). Phys. Rev., D; 1: 1514(1 Mar 1970).

An expansion for the scattering amplitude at high energy is given. The expression given by Ross, with his $\gamma(\theta) = 0$, appears as the first term, and the higher-order terms may therefore be used to estimate the accuracy of the approximation $\gamma(\theta) = 0$. Schiff's large-angle formula is also obtained. The derivations are simple, and physical motivation is emphasized. (auth)

35716 DOUBLED RESONANCES IN THE EIGENCHANNEL REPRESENTATION. Rebbi, Claudio (California Inst. of Tech., Pasadena); Slansky, Richard. Contract AT(11-1)-68. Phys. Rev., D; 1: 1499-1500(1 Mar 1970).

The eigenamplitudes of the unitary doubled-resonance amplitude for the two-channel case are computed and discussed. In addition to poles, the eigenamplitudes also have square-root branch points in the complex energy plane. (auth)

35717 NONUNIQUENESS OF THE ENERGY CORRECTION IN APPLICATION OF THE WKB APPROXIMATION TO RADIAL PROBLEMS. Engelke, Ray; Beckel, Charles L. (Univ. of New Mexico, Albuquerque). J. Math. Phys. (N. Y.); 11: 1991-4 (Jun 1970).

An infinite set of transformations is given that convert a radial energy-eigenvalue problem into a 1-dimensional problem. Langer's transformations are included in this set. The transformations introduce no spurious, real-axis singularities into the effective potential, and yield wavefunctions that meet 1-dimensional boundary conditions and are asymptotically satisfactory for virtually all power law potentials. The first-order radial WKB quantization condition is transformation dependent through two parameters. It may be distinct from the Langer–Kemble condition obtained by substituting $(l + \frac{1}{2})^2$ for $l(l + 1)$ in the effective potential. Here, l is the rotational quantum number. For the vibrating rotator, a rough test of the usefulness of the $(l + \frac{1}{2})^2$ substitution is described; flexibility advantages provided by the new transformations are pointed out. (auth)

35718 NUMERICAL ANALYSIS OF AN INTEGRAL EQUATION WITH A δ FUNCTION IN THE KERNEL. Hetherington, J. H. (Michigan State Univ., East Lansing). J. Math. Phys. (N. Y.); 11: 1829-34(Jun 1970).

An integral equation which has a two-part kernel, where one part contains a δ function, is analyzed with respect to its analytic structure in the λ plane and with respect to numerical approximations to it. The analytic structure of the approximate solution is also investigated. It is found that there is no difficulty in approximating the Dirac δ function by a Kronecker δ; even though the approximate kernel does not approach the true kernel, the solution corresponding to the approximate kernel does approach the true solution. In keeping with the fact that the kernel does not meet the Fredholm conditions, it is found that the solution has branch cuts in the λ plane. A form for the solution analogous to Fredholm's solution which emphasizes the analytic structure (i.e., a branch cut) is obtained. (auth)

35719 SCATTERING IN GENERAL HIGHER SECTORS OF THE LEE MODEL. Liu, Tsu-huei; Zimmerman, Robert L. (Univ. of Oregon, Eugene). J. Math. Phys. (N. Y.); 11: 1941-54(Jun 1970).

The technique of an iterative expansion in terms of the 2-body solution used in $V-2\theta$ sector of the Lee model is extended to the general higher sector, i.e., $V-n\theta$ sector with $n > 2$ so that S matrices for the general cases of scattering $(n-1)\theta$ particles off the $(V\theta)$ bound state can be calculated. Again, as in $V-2\theta$ sector, each term of the expansion preserves the properties of the $(V\theta)$ bound state, the analytic structure, and symmetries of the τ functions. (auth)

35720 HIGH-ENERGY BEHAVIOR OF THE FEYNMAN AMPLITUDE AND GAUGE INVARIANCE. Shimizu, Y. (Tokyo Univ.). Lett. Nuovo Cim.; 3: 633-8(16 May 1970).

The problem of fixed poles in the complex-angular-momentum plan was recently discussed (Phys. Rev., 167: 1441(1968)) through the analysis of the high-energy behavior of the Feynman amplitude for the photoproduction of a charged scalar meson ϵ^+. The contribution of the amplitude $A(\nu,t)$ from the ladder diagrams was calculated to give the Mellin transform of the amplitude $A(\lambda,t)$; the sum of the ladder diagrams gives rise to a fixed pole at $\lambda = -1$. It is shown that $A(\lambda,t)$ has extra fixed poles at $\lambda = -2$ of the first and second order, and that the latter singularity in $A(\lambda,t)$ can be eliminated by means of the gauge-invariance condition. (L.B.S.)

35721 EQUIVALENCE BETWEEN CINI-FUBINI APPROXIMANTS AND DIAGONAL PADE APPROXIMANTS. Georgalas, C. G. (Democritos Nuclear Research Center, Athens). Z. Naturforsch., 25a: 447-8(Mar 1970).

The Cini-Fubini approximants are equal to the diagonal Padé approximants to the S-matrix. A simple proof of this statement is given. (auth)

35722 LORENTZ EXPANSION OF A MULTIPARTICLE AMPLITUDE. Cosenza, G. (Univ., Naples. Istituto Nazionale di Fisica Nucleare, Naples); Sciarrino, A. Nuovo Cim.; 68A: 11-38(1 Jul 1970).

An asymptotic expansion of a multiparticle amplitude, written in terms of group-theoretical variables and free of kinematical singularities and constraints, is derived in terms of Lorentz pole contributions. The covariance relations of the amplitude are explicitly taken into account in order to express the Lorentz residues in terms of a set of analytic functions with explicitly known kinematical factors. The connection with the BCP amplitude is derived. Massive particles of arbitrary spin and parity are considered. The zeros of the residue functions at integral values of the Lorentz trajectory are briefly discussed. (auth)

35723 ON PROPERTIES OF AMPLITUDES NOT SATISFYING THE POMERANCHUK THEOREM CONDITIONS. Gribov, V. N.; Kobsarev, I. Yu.; Mur, V. D.; Okun, L. B.; Popov, V. S. (Academy of Sciences, Moscow). Phys. Lett.; 32B: 129-32(8 Jun 1970).

Properties of the scattering amplitudes as functions of the momentum transfer (t) and of the impact parameter (ρ) are investigated in the case when the total cross sections for particle (p) and antiparticle (a) are asymptotically ($s \to \infty$) constant and are not equal to each other. It is shown that if the equality $\mathrm{Im}F^p(s,t) = \mathrm{Im}F^a(s,t)$ is violated, the weaker integral equality $\int \mathrm{Im}F^p(s,t)\, s^{-2}ds \approx \int \mathrm{Im}F^a(s,t)s^{-2}ds$, $t < 0$ must hold. This equality provides for the absence of singularities at $t = 0$ in the amplitude. It follows from this equality that t- (and s-) dependence of $\mathrm{Im}F^p$ and $\mathrm{Im}F^a$ must be different. (auth)

35724 ELEMENTARY PARTICLE PHYSICS AND SCATTERING THEORY. VOLUME 1. Chretien, M.; Schweber, S. S. (eds.). Brandeis University Summer Institute in Theoretical Physics, 1967. New York; Gordon and Breach, Science Publishers, Inc. (1970). 473p. $29.50.

The book contained five lectures. Separate abstracts were prepared for each lecture. (J.F.P.)

For abstracts of individual lectures see: 35620–35622, 35725, and 35726.

35725 HIGH-ENERGY BEHAVIOR OF SCATTERING AMPLITUDES. Low, F. E. (Massachusetts Inst. of Tech., Cambridge). pp 137-208 of Elementary Particle Physics and Scattering Theory. Vol. 1. /Chretien, M. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1970).

The theoretical framework of Regge pole theory is discussed. Cuts and fixed poles in strong amplitudes and fixed poles in higher spin weak amplitudes are considered. (J.F.P.)

35726 SINGULARITIES IN THE COMPLEX ANGULAR MOMENTUM PLANE. Teplitz, V. L. (Massachusetts Inst. of Tech., Cambridge). pp 307-62 of Elementary Particle Physics and Scattering Theory. Vol. 1. /Chretien, M. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1970).

The singularities of partial-wave scattering amplitudes in the complex angular momentum plane are discussed in some detail. Moving singularities such as Regge poles and branch points are considered. Types of singularities in the l-plane, existence of moving branch points in the l-plane, experimental evidence for cuts, the Gribov-Pomeranchuk phenomenon, and type-1 and type-2 branch points in the l-plane are covered. Also included are the asymptotic behavior of pole trajectories and the signature of $2 \rightarrow 2$ and $2 \rightarrow 3$ amplitudes. (J.F.P.)

Particle Accelerators

Refer also to abstracts 35525 and 35938.

35727 (BNL-tr-346) FORMING AND TRAPPING OF A GASEOUS HYDROGEN JET IN A VACUUM. Zolin, L. S.; Nikitin, V. A.; Pilipenko, Yu. K. (Joint Inst. for Nuclear Research, Dubna (USSR)). Translated by S. J. Amoretty (Brookhaven National Lab., Upton, N. Y.), from report JINR-P13-3425. 26p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 21: 46613.

35728 (CERN-70-16) RADIATION MEASUREMENTS AROUND A BEAM STOPPER IRRADIATED BY 19.2 GeV/c PROTONS, AND NEUTRON ENERGY SPECTRA FROM MONTE CARLO NUCLEON-MESON CASCADE CALCULATIONS. Goebel, K.; Ranft, J. (European Organization for Nuclear Research, Geneva (Switzerland)). 27 May 1970. 21p. Dep. CFSTI (U. S. Sales Only).

Flux density measurements around a 300-cm-long steel beam stopper are made by using activation detectors with different energy thresholds. These measurements, from 21 positions inside and 10 outside the shielding tunnel, provide information on the radiation at these positions, the spectrum of secondary neutrons, and attenuation by and shielding efficiency of the beam stopper and the concrete shielding tunnel, respectively. Calculations using a Monte Carlo method are made to evaluate the flux densities and spectra above 100 MeV. These calculations and the experimental data are compared, and it shown that both agree in general within a factor of 2. (auth)

35729 (JINR-P9-5032) ION MOTION IN THE CENTER OF THE JINR 2-METER ISOCHRONOUS CYCLOTRON. Shelaev, I. A.; Kozlov, S. I.; Nikolaev, V. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1970. 16p. (In Russian). Dep. CFSTI (U. S. Sales Only).

The results of computer calculations of the initial motion of heavy ions in the JINR 2-meter isochronous cyclotron using experimentally obtained distributions of electrical and magnetic fields are presented. Optimum position of the ion source, providing a minimum amplitude of radial oscillations and an axial ion focusing, is determined. (auth)

35730 (JINR-P9-5048) PARAMETERS OF THE ACCELERATED ION BEAMS FROM THE 2-METER JINR ISOCHRONOUS CYCLOTRON. Shelaev, I. A.; Alfeev, V. S.; Kozlov, S. I.; Nikolaev, V. M.; Oganesyan, R. Ts. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1970. 11p. (In Russian). Dep. CFSTI (U. S. Sales Only).

Experimentally measured parameters of the beams from the 2-meter JINR isochronous cyclotron are presented. (auth)

35731 (JINR-P9-5091) ON COLLECTIVE BEAM ACCELERATION. Tsytovich, V. N. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1970. 10p. (In Russian). Dep. CFSTI (U. S. Sales Only).

The possibilities of acceleration of plasma bunches and relativistic electron rings using the action of relativistic electron beams are discussed. The acceleration due to the coherent Cherenkov and coherent transitional radiation is considered. (auth)

35732 (KFK-1010) DEVELOPMENT OF A VARIABLE CONDUCTOR WITH A CHARACTERISTIC IMPEDANCE $Z_0 = 100\ \Omega$. Fischer, P. M.; Husson, L. (Kernforschungszentrum, Karlsruhe (West Germany). Labor fuer Elektronik und Messtechnik). Mar 1969. 30p. (In German). Dep. CFSTI (U.S. Sales Only).

To deflect a cyclotron beam, a meander system of conductors with a wave resistance of $Z_0 = 100\ \Omega$ was developed. It consisted of a plate covered with strip conductors. Arrangement of the conductors was determined by mathematical and experimental approximation procedures and, also, by direct mathematical analysis based on the predetermined wave resistance of Z_0. (tr-auth)

35733 (KFK-tr-315) KINETICS OF THE ELECTRON BEAM COOLING IN STORAGE RINGS FOR HEAVY PARTICLES. Derbenev, Ya. S.; Skrinskii, A. N. (Akademiya Nauk SSSR, Novosibirsk. Institut Yadernoi Fiziki). Translated by Rosemarie Corssen (Kernforschungszentrum, Karlsruhe, W. Ger.), from Preprint 255. 46p. (In German). Dep. CFSTI (U. S. Sales Only).

The kinetic characteristics of the method of electron beam cooling in storage rings for heavy particles were investigated. A kinetic equation for the particle beam, which periodically passes the secondary electron flux, was given on the basis of the Landau collision integral for the Coulomb interaction. In addition to the electron collisions, the scattering on coherent fluctuations (nonthermodynamic origin) of the space charge of the electron beam and on the atoms of the residual gas was calculated. The final kinetic equation is the Fokker-Planck equation in the working variables. The effect of the deviations in the electron flux in a state of thermodynamic equilibrium on the kinetic process was investigated. The dependence of the damping rate and the stable values of the angular and energy scattering on the velocity distribution of the electrons and the space heterogeneity of the electron beam in the radial direction was investigated qualitatively. The permissible coherent noise level in the electron flux was estimated. The solution of the kinetic equation was determined in the small region ($\Theta_p < \Theta_s$). The theorem of the sum of the oscillation decrements was established. The type of solution in the area of large amplitudes was investigated. (tr-auth)

35734 (LNF-69/45) ON A NEW INSTABILITY IN ELECTRON-POSITRON STORAGE RINGS (THE HEAD-TAIL EFFECT). Note No. 448. Pellegrini, C. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 17 Jun 1969. 31p. Dep. CFSTI (U. S. Sales Only).

Single-turn or head-tail instabilities in electron-positron storage rings are studied. A particle of the beam, going through the material structures surrounding the beam, produces on it a signal proportional to its oscillation amplitude; the electromagnetic field thus produced acts on the particles which go through the same structure at subsequent times. Hence on these particles acts a force proportional to the induced signal delayed in time by a quantity proportional to the particle distance. If the phase relationship in the oscillation of the particles is appropriate, this will produce an increase of oscillation amplitude. The general equations of motion are reduced to a linear system of homogeneous equations, and it is shown that for a storage ring in which the change in betatron wave number with energy is zero, the head-tail effect does not introduce instabilities. Then the problem is reduced to the solution of an infinite set of linear homogeneous integral equations whose eigenvalues determine the characteristics of the bunch motion. Two approximate solutions of these integral equations are discussed. (W.H.K.)

35735 (LNF-69/70) ELECTRO-MAGNETIC FIELD OF AN INTENSE COASTING BEAM PERTURBATION IN THE PRESENCE OF CONDUCTIVE PLATES TERMINATED AT BOTH ENDS. Note No. 457. Ruggiero, A. G.; Vaccaro, V. G. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 20 Nov 1969. 25p. Dep. CFSTI (U. S. Sales Only).

A theoretical investigation to study coherent instabilities of intense coasting beams which have been observed in particle accelerators and storage rings is presented. The fields produced by a coherent oscillating beam in the presence of conductive plates terminated at both ends are analyzed. The termination impedances are used as variables. A beam perturbation with z, t-dependence of the kind $\exp[-i(kz-\omega t)]$, traveling along a continuous beam with circular cross section and placed at the center of a cylindrical straight pipe is studied. The perturbation is taken to be any mode of transverse throbbing configuration. Also, the effect of a longitudinally perturbed beam is investigated. (W.H.K.)

35736 (NAL-41) FIRST MAGNET GOES INTO MAIN RING. Monthly Report of Activities, April 30, 1970. Cole, F. T. (National Accelerator Lab., Batavia, Ill.). 12p. Dep. CFSTI.

It was announced that the first proton beam may be accelerated by mid-1971 to an energy of 500 GeV. Construction progress on the linac, booster, main accelerator, beam transfer system, and experimental facilities is summarized. The statement made by R. R. Wilson at the second annual meeting of the NAL Users Organization on April 10, 1970, concerning the schedule and energy is included. (W.H.K.)

35737 (NAL-42) THE MASTER SUBSTATION. Monthly Report of Activities, May 31, 1970. Cole, F. T. (National Accelerator Lab., Batavia, Ill.). 12p. Dep. CFSTI.

The fabrication and 10-MeV operation of the linac are discussed, and progress on the booster, main accelerator, beam transfer system, and experimental facilities is outlined. Construction progress is reported. (W.H.K.)

35738 (NBS-TN-522) BEAM HANDLING TECHNIQUES FOR ELECTRON LINEAR ACCELERATORS. Penner, Samuel (National Bureau of Standards, Washington, D. C.). Apr 1970. 16p. GPO.

The design of beam transport systems for electron linear accelerators intended for nuclear physics research is discussed. The subjects covered include beam optics, diagnostics and control of electron beams, and problems of handling high power beams. (auth)

35739 (NP-18201) STUDY OF THE PROPAGATION OF ELECTROMAGNETIC WAVES ALONG HELICOIDAL CONDUCTORS. INFLUENCE OF THICKNESS OF THE WIRE ON THE PHASE VELOCITY. Crouzet, J. (Paris Univ., Orsay (France). Faculte des Sciences). 18 Feb 1970. 140p. (In French). Dep. CFSTI (U. S. Sales Only).

Thesis.

The phase velocity of the electromagnetic wave circulating on a helical wire is studied from the viewpoint of using the helicoidal structure as a low energy proton linear accelerator. For an accelerator it is essential to know exactly the phase velocity. A systematic study was made of the effect of the radius r_θ of a conductor wire coiled into a helix on the phase velocity of the electromagnetic wave circulating on this thick conductor wire. The study was made for various oscillation frequencies. From the experimental data an attempt is made to develop an initiation of a helicoidal field theory. The experimental study showed the validity of the $[v_f/c\ (r_\theta)]$ law. Consequently it is remarkable to have to affirm that for radii of conductor wire practically possible, the phase velocity of an electromagnetic wave on a helicoidal conductor is quasi independent of the radius r_θ of the wire. This property can be of great importance in a mechanical realization: the choice of r_θ is without effect on (v_f/c). If this law is remarkable by its plateau, it appears difficult to explain theoretically. (tr-auth)

35740 (OU-LNS-70-1) ANNUAL REPORT, JANUARY 1969-DECEMBER 1969. (Osaka Univ. (Japan). Lab. of Nuclear Studies). 25p. Dep. CFSTI (U. S. Sales Only).

This report is a review of the research and technical development conducted at the Laboratory of Nuclear Studies, Osaka University during the year ending December 1969. The work was performed primarily by faculty and graduate students of the Department of Physics, Chemistry and Biology and by the staff of the Laboratory. The principal facilities of the Laboratory are a 110 cm cyclotron, a 4-MeV Van de Graaff accelerator, a 400-keV Cockcroft-Walton accelerator, and several types of mass-spectrometers. The design study for the construction of a 230 cm isochronous cyclotron and accessory equipment was continued this year. The Ministry of Education agreed to start the construction in the fiscal year 1970. The site of the new cyclotron will be Suita Campus of Osaka University (about 4 km apart from Toyonaka Campus), and the facility will be operated by cooperative works of the nuclear research groups in the whole country. (auth)

35741 (RHEL/R-194) NIMROD OPERATION AND DEVELOPMENT QUARTERLY REPORT, JULY 1-SEPTEMBER 30, 1969. Gray, D. E. (ed.) (Rutherford High Energy Lab., Chilton (England)). Feb 1970. 26p. Dep. CFSTI (U. S. Sales Only). UK 5s. 6d.

The Nimrod beam was on for High Energy Physics Research for 87.2% of H.E.P. scheduled operating time. One experiment was completed, two commenced, and twelve continued through in this quarter. A review of extracted proton beams on Nimrod is given. The third extracted proton beam X3 has been commissioned successfully. (auth)

35742 (RHEL/R-195) NIMROD OPERATION AND DEVELOPMENT. Quarterly Report, October 1-December 31, 1969. Gray, D. E. (ed.) (Rutherford High Energy Lab., Chilton (England)). Mar 1970. 16p. Dep. CFSTI (U. S. Sales Only). UK 3s. 0d.

The Nimrod beam was on for High Energy Physics Research for 87.7% of H.E.P. scheduled operating time. Three experiments were completed, ten continued through, and one commenced in this quarter. (auth)

35743 (SLAC-Trans-114) DAMPING THE COHERENT OSCILLATIONS OF A BEAM IN A STORAGE RING. Derbenev, Ya. S.; Dikanskii, N. S. (Akademiya Nauk SSSR, Novosibirsk. Institut Yadernoi Fiziki). Translated for Stanford Linear Accelerator Center, Calif., from Preprint No. 318. 19p. Dep. CFSTI.

The stability of the coherent phase motion of a beam interacting, along a segment of the chamber, with an ideally matched line, is investigated. It is shown that under certain conditions this interaction may result in so-called "memory-less" instabilities of the synchrotron and radial betatron motion. The damping conditions and expressions for the decrements of synchrotron excitations of arbitrary multipolarity are also derived. (auth)

35744 (SLAC-Trans-115) STABILITY OF A BEAM INTERACTING WITH A LOW-Q RESONATOR. Derbenev, Ya. S.; Dikanskii, N. S. (Akademiya Nauk SSSR, Novosibirsk. Institut Yadernoi Fiziki). Translated for Stanford Linear Accelerator Center, Calif., from Preprint No. 326. 12p. Dep. CFSTI.

The coherent transverse stability of a short beam interacting with a low-Q resonator is investigated. It is shown that this interaction may result in so-called memoryless instabilities. (auth)

35745 (SLAC-Trans-116) COLLIDING-BEAM EFFECT. PART ONE. PERTURBATION UNDERGONE BY A PARTICLE CROSSING A BUNCH. Augustin, J. E. (Paris Univ., Orsay (France). Laboratoire de l'Accelerateur Lineaire). Translated by R. Addis for Stanford Linear Accelerator Center, Calif., from report 36-69-JEA-LN. 16p. Dep. CFSTI.

In an electron-positron storage ring the motion of a particle crossing a bunch of the opposed beam is modified by the electromagnetic force due to the charge of the bunch. The bunches of particles have a trigaussian density, and this property is used to calculate exactly the angular perturbation undergone by the particle, which is obtained in particular in the form of a series expansion having as parameters the amplitudes of the particle's betatron oscillations. The result will be applied to various effects pertaining to the space-charge compensation in a four-beam machine (Coppélia project), as well as the resultant distribution of wave numbers in the beams. Angular perturbation in a head-on collision and crossing at an angle are considered. (auth)

35746 (SLAC-Trans-117) COLLIDING-BEAM EFFECT. PART TWO. WAVE-NUMBER DRIFT; CASE OF TWO BEAMS; APPLICATION TO TRANSVERSE INSTABILITY CREATED BY SECOND BEAM; APPLICATION TO SPACE-CHARGE COMPENSATION WITH FOUR BEAMS. Augustin, J. E. (Paris Univ., Orsay (France). Laboratoire de l'Accelerateur Lineaire). Translated by R. Addis for Stanford Linear Accelerator Center, Calif., from report 8-70-JEA-LN. 27p. Dep. CFSTI.

After calculating the general formula giving the wave-number drift for a particle, the head-on collision between two beams circulating in the same orbit is studied. In this case it is possible to calculate completely the distribution of the wave numbers in the beams. The result is used to explain an observation made with the Orsay storage ring, namely that the presence of a second beam of low intensity may produce a transverse instability in the already stored beam. This is interpreted as a modification of the Landau damping in that beam due to a change in the distribution of its wave numbers caused by the weak beam. (auth)

35747 ELECTROSTATIC MACHINES, PARTICLE ACCELERATORS, AND INDUSTRY. Casimir, H. B. G. Philips Tech. Rev.; 30: 309-11(1969).

As introduction to two articles about five major proton synchrotrons, a historical sketch is given of the efforts to apply ever higher voltages and ever higher energies to the investigation of elementary particles. A few steps in the related growth of our knowledge of these particles are indicated. (auth)

35748 FOCAL PROPERTIES OF THREE-ELEMENT ELECTROSTATIC ELECTRON LENSES. Heddle, D. W. O.; Kurepa, M. V. (Univ. of York, Eng.). J. Phys., E (London); 3: 552-4 (Jul 1970).

The focal loci of a number of three-element lenses have been measured and compared with calculations made using the design procedure of Heddle. Very good agreement is found provided that only paraxial rays are used. (auth) (UK)

35749 FERROXCUBE FOR PROTON SYNCHROTRONS. Brockman, F. G. (Philips Labs., Briarcliff Manor, N. Y.); van der Heide, H.; Louwerse, M. W. Philips Tech. Rev.; 30: 312-29(1969).

Philips have supplied the cores of ferroxcube for the accelerating stations of the proton synchrotrons at Brookhaven, Geneva, Argonne, Chilton and Princeton. These machines are among the largest accelerators in the world. The amount of ferroxcube material in the various machines ranges from 1760 to 8400 kg. An accelerating station can be considered as an inductor with the accelerating voltage across its ends. The ferroxcube serves as a core for the inductor and as a means of tuning the station to the orbital frequency of the protons. This is effected by controlling the incremental permeability of the ferroxcube by a magnetic biasing field. Varieties of ferroxcube 4 are suitable for such an appli-

cation. The optimum composition varies from synchrotron to synchrotron. To obtain a product of the required dimensions (some rings are 50 cm in diameter) and of sufficient homogeneity and strength, firing must be carried out with care. Special measures have to be taken to prevent the formation of ferrous ions, which tend to increase the losses. (auth)

35750 FIVE MAJOR PROTON SYNCHROTRONS. Gouiran, R. (CERN, Geneva). Philips Tech. Rev.; 30: 330-65(1969).

This article about five proton synchrotrons (3 to 30 GeV) was prompted by the fact that Philips have supplied the ferroxcube for these machines. The opportunity for comparison allows the special features of each machine to be brought out clearly. The first part (a general description of a proton synchrotron) gives an account of the basic principles (guiding field, radius of curvature, final energy, accelerating voltage, synchronization) and pays special attention to the proton-orbit stability and the accelerator focusing characteristics: transverse focusing (CG, AG, ZG principle; betatron oscillations) and longitudinal or phase focusing (synchrotron oscillations; phase jump at the transition energy); finally the injection of the protons into the ring is discussed. In the second part the special features of the five synchrotrons are discussed with the aid of numerical data. (1) The Alternating Gradient Synchrotron (Brookhaven, U.S.A.; 33 GeV) and (2) the CERN Proton Synchrotron (Geneva; 28 GeV) are AG accelerators (transition energy; narrow vacuum chamber); (3) the Zero Gradient Synchrotron (Argonne, U.S.A.; 12.7 GeV) has a high final field and is relatively compact; (4) Nimrod (Chilton, England; 7 GeV) has a large vacuum chamber for super-high intensities; (5) the Princeton–Pennsylvania Accelerator (Princeton, U.S.A.; 3 GeV) is a fast-cycling machine. (auth)

35751 X-RAY MEASUREMENTS NEAR HIGH-POWER KLYSTRONS. Lehman, Richard L. (Massachusetts Inst. of Tech., Cambridge). Science; 169: 52-4(3 Jul 1970).

The intensity and quality of the x-radiation outside the lead shielding around ultrahigh-frequency and S-band klystrons were measured as a function of high voltage, pulse frequency, and microwave power output by use of ionization chambers. Independent 20 percent increases in each variable gave, respectively, 8-, 1.2-, and 1.5-fold increases in the intensity, and 36, 1, and 4 percent increases in the mean energy of the x-rays. (auth)

35752 STUDY OF THE STATIONARY STATE OF AN ANNULAR BEAM OF MONOENERGETIC ELECTRONS. Gratreau, P. (EURATOM-CNEN, Rome). Plasma Phys.; 11: 1001-15(Dec 1969). (In French).

The stationary state of a high-intensity toroidal electron beam of finite small diameter is studied, in a first approximation, assuming that the electrons are monoenergetic and have the same equilibrium orbit. A self-consistent solution of the Boltzmann and Maxwell equations is found, which satisfies the boundary conditions at the interface between the beam and vacuum. This study would be of interest for the formation by a betatron, of the high current electron beams required by the recently proposed "electron ring accelerators." (auth) (UK)

35753 COMPUTER CONTROL OF A NUMBER OF ANALYZING MAGNETS AT THE VAN DE GRAAFF FACILITY OF THE LOS ALAMOS SCIENTIFIC LABORATORY. Lang, H. J.; McMillan, D. E. (Los Alamos Scientific Lab., N. Mex.). Nucl. Instrum. Methods; 82: 109-13(1970).

A system is described which can calculate, set up, and control the frequency of a nuclear resonance fluxmeter using an on-line control computer. The magnetic field of an associated analyzing magnet is adjusted by the computer to produce and maintain a resonance signal. This can be accomplished for a number of magnets and particles accelerated by either one or two Van de Graaff accelerators. (auth)

35754 FLOATING WIRE METHOD FOR DETERMINING THE USEFUL APERTURE OF A MAGNETIC QUADRUPOLE LENS. Hagedoorn, H. L.; Broer, J. W.; Ooms, P. F. M. (Technological Univ., Eindhoven, Netherlands). Nucl. Instrum. Methods; 82: 114-16(1970).

The floating wire method is applied to determine the useful aperture of a magnetic quadrupole lens. Within the useful aperture nonlinear behaviour corresponding to spherical aberration does not exceed a specified value. The optical distance between two points upon the axis of a (thin) lens is considered. It is, mainly, a quadratic function of the distance between a particular trajectory and the optical axis in the lens. The nonlinearity results from a sixth degree term. Dependent upon the sign of the quadratic function, three cases are distinguished. The behaviour of the floating wire confirms the theoretical considerations. For the measured quadrupole lens (geometrical length 15 cm, aperture radius 2.75 cm) the aberration, expressed as a fraction of the paraxial lens strength, is smaller than 1×10^{-3} within 80% of the radius. (auth)

35755 TWISTED ELECTROSTATIC QUADRUPOLE FOR GUIDING HEAVY CHARGED PARTICLES. Chute, F. S.; Vermeulen, F. E.; Youssef, E. A. (Univ. of Alberta, Edmonton). Nucl. Instrum. Methods; 82: 86-92(1970).

A study is made of the guiding properties of a long electrostatic quadrupole that has been uniformly twisted about its axis. It is shown that stable trajectories exist for particles of arbitrary charge to mass ratio. Possible applications include beam transport elements for heavy particle accelerators, structures for plasma confinement, and devices for guiding the exhaust beams of colloidal propulsion engines in space. (auth)

35756 ADIABATIC TRANSITIONS IN A POLARIZED DEUTERON SOURCE. Oh, Saewoong (Univ. of Birmingham, Eng.). Nucl. Instrum. Methods; 82: 189-97(1970).

The 7.5 MHz multiple level adiabatic transitions for the hyperfine states of deuterium used in many polarized deuteron sources is usually described by the weak field limit approximation. A detailed computer study shows, however, that the approximation does not apply to this 7.5 MHz transition. The transition produces a pure vector polarization of −66% with a positive field gradient, while it produces a tensor polarization of about 33% with an admixture of about −35% vector polarization when the sense of the gradient is reversed. These calculations have been verified experimentally. Computer studies have also been made of the adiabatic two-level transition $\phi_2 \rightarrow \phi_5$ and $\phi_3 \rightarrow \phi_6$ at 14 G static field (329.4 MHz). (auth)

35757 DYNAMIC PROTON POLARIZATION IN AMMONIA. Scheffler, K. (CERN, Geneva). Nucl. Instrum. Methods; 82: 205-7(1970).

By means of dynamic nuclear orientation, we have polarized the protons of ammonia (NH_3) reproducibly up to 40% at 1 K and 25 kG. (auth)

35758 MEASUREMENT OF QUADRUPOLE LENS PARAMETERS. Lee-Whiting, G. E. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Nucl. Instrum. Methods; 82: 157-61(1970).

A spinning-coil method is proposed for measuring the more important form-factors occurring in the first-order theory of a lens segment in which the magnetic gradient varies along the axis. Because series containing the contributions from higher-order terms have been summed, the method is not restricted to coil diameters very small compared to the throat of the lens. (auth)

35759 RF-PULSE METHOD FOR MATCHING MODE TRANSFORMERS ON DISK-LOADED WAVEGUIDES. Bernard, Ph. (CERN, Geneva); Lengeler, H.; Vaghin, V. Nucl. Instrum. Methods; 82: 319-20(1970).

A simple and very fast method using short rf-pulses for matching mode transformers on disk-loaded waveguides has been developed and tested. The method is described and some experimental results are given. (auth)

35760 EXPERIMENTAL STUDY ON A CIRCULARLY POLARIZED DEFLECTING MODE IN A DISK-LOADED WAVEGUIDE. Bernard, Ph. (CERN, Geneva); Lengeler, H.; Vaghin, V. Nucl. Instrum. Methods; 82: 321-2(1970).

A circularly polarized deflecting mode has been obtained by combining two linearly polarized modes with polarization planes at 90° in a disk-loaded waveguide. An adequate mode transformer has been developed. (auth)

35761 ORGANIC POLARIZED PROTON TARGET, USING A CONTINUOUS FLOW ^{3}He CRYOSTAT. Roubeau, P. (Centre d'Etudes Nucleaires, Saclay, France); Ezratty, J.; Glaettli, H.; Vermeulen, J.; Borghini, M. Nucl. Instrum. Methods; 82: 323-4(1970).

We have constructed a continuous flow ^{3}He cryostat with a cooling power up to 65 mW. We have achieved 65 to 70% proton polarization in butanol or glycol samples of 6 cm^3 at 0.55 K with 12 mW microwave power. (auth)

35762 BEAM ENVELOPE OF AN INITIALLY UNCORRELATED ELLIPSOIDAL BEAM. Lobb, D. E. (Univ. of Victoria, Can.). Nucl. Instrum. Methods; 82: 331-3(1970).

A method is presented for the calculation of the beam envelope using the ray trace of certain specified initial rays. (auth)

35763 UNIFORM IRRADIATION OF A METAL BALL USING A CYCLOTRON. Golam Mostafa, A. B. M.; Fremlin, J. H. (Univ. of Birmingham, Eng.). Nucl. Instrum. Methods; 82: 313-15(1970).

A simple system has been developed to irradiate a metal ball

uniformly. Three compressed air jets have been made to spin and simultaneously to cool the ball during irradiation. A rise of temperature of about 35°C per microampere of beam current during irradiation has been recorded. A 20 min irradiation has been found to be sufficient to obtain about 98% uniformity of activation. (auth)

35764 ENERGY CALIBRATION METHOD FOR BEAM ANALYZER-MAGNETIC SPECTROGRAPH COMBINATIONS. Trentelman, G. F.; Kashy, E. (Michigan State Univ., East Lansing). Nucl. Instrum. Methods; 82: 304-6(1970).

A method of energy calibration for beam analyzer-magnetic spectrograph combinations is described which promises highly accurate results for beam energies equivalent to 20 to 100 MeV protons. (auth)

35765 METHODS TO COMPUTE THE OPTICS OF BEAM TRANSFER CHANNELS. Burton, G.; Hanney, P. M.; De Raad, B.; Strolin, P. (CERN, Geneva). Nucl. Instrum. Methods; 82: 259-63(1970).

In the course of the design of the beam transfer channels for the Intersecting Storage Rings project at CERN, Geneva, a computer program has been developed capable of performing all the operations necessary for the design of extensive beam transport systems, viz., the matching of phase-space ellipses and momentum compaction and the computation of beam envelopes along a channel, trajectories of particles, transfer matrices, betatron parameters of periodic magnetic lattices, and geometry of central orbits. (auth)

35766 INFLUENCE OF THE ERRORS OF MAGNETIC FIELD MEASUREMENTS ON THE IMPORTANT PROPERTIES OF AN OPTICAL SYSTEM. Ribes, M.; Turck, B. (Centre d'Etudes Nucleaires Saclay, France). Nucl. Instrum. Methods; 82: 131-7(1970). (In French).

It is usual to ask the magnetic measurement systems to give accuracies better than the accuracy needed for the experiment. Our study shows that this requirement is not always necessary. Using a trajectory program we analyze, for a beam issued from a point object, the image aberrations created by measurement errors of different nature and magnitude. It is pointed out that if the errors at each point of measurement are not quite independent, the overall effect may be, in some cases, practically negligible. (auth)

35767 CHARACTERISTICS OF LIGHT-ION SOURCE FOR U-200 CYCLOTRON. Taut, T.; Shelaev, I. A.; Solov'eva, G. M. (Joint Inst. for Nuclear Research, Dubna, USSR). Rev. Roum. Phys.; 15: 27-33(1970). (In Russian).

The characteristics of the He_3^{+1}, He_4^{+1}, DH^{+1}, H_3^{+1}, and D_2^{+1} ion source are given. These properties include the dependence of the ion current on the output of gas, on the discharge current and voltage, on the voltage of the dees, and on the position of the slit of the source in relation to the exciting electrode. The results are discussed. (tr-auth)

35768 ACCELERATION OF MULTICHARGED HEAVY IONS IN IPCR (RIKEN) ORDINARY 160-cm CYCLOTRON. Miyazawa, Yoshitoshi; Tonuma, Tadao; Kohno, Isao; Nakajima, Shunji; Inoue, Toshihiko; Shimamura, Akira.; Yoshida, Kisaku; Karasawa, Takashi (Inst. of Physical and Chemical Research, Yamato, Japan). Jap. J. Appl. Phys.; 9: 532-41(May 1970).

In the IPCR (Riken) 160 cm ordinary cyclotron the operation ranges of electromagnet and radio frequency system are 0.5 to 2.0 wb/m^2 and 5.0 to 12.0 MHz respectively, and various particles of different mass to charge ratios from proton to Ne^{5+} ion can be accelerated with variable energy. Multicharged heavy ion sources of electron bombarded hot cathode type for this cyclotron have been developed to produce C^{4+}, N^{4+}, O^{4+}, N^{5+} and O^{5+} ions. At present these ions are produced in sufficient quantities under arc power of 2.0 to 2.5 kW. The source life is mainly limited by the erosion of tungsten cathode at about 20 hours. The attenuation of beam current by charge exchange collision with residual molecules and the spectra of various ions accelerated in the cyclotron are discussed. C^{4+}, N^{4+}, and O^{4+} ions are accelerated up to 39 to 120 MeV, 45 to 100 MeV and 52 to 100 MeV respectively and used for several experiments. (auth)

35769 LIMITING CURRENT IN LINEAR ACCELERATOR WITH INDIFFERENT INITIAL EQUILIBRIUM OF BUNCHES. Vlasov, A. D. At. Energ. (USSR); 28: 220-4(Mar 1970). (In Russian).

An attempt was made to evaluate the maximum current of protons achieved in a linear accelerator without the loss of particles, taking into account the rate of acceleration. The analysis was confined to studies of the clusters after injection into the accelerator in indifferent equilibrium. With the initial acceleration the indifferent equilibrium of the clusters became stable and their stability improved with the increased velocity. However, an injection of denser and longer clusters did not acquire stability during first stages of acceleration and loss of particles in this case was unavoidable. So, experiments were carried out for the first case of smaller clusters of particle in indifferent equilibrium which became stable with acceleration. The results produced sufficiently accurate data on the maximum current achieved without loss of particles in a proton linear accelerator with prearranged grouping. (R.V.J.)

35770 PRINCIPLE OF LOCAL SHIELDING OF RADIATION SOURCES IN ACCELERATORS. Zaitsev, L. N. This paper was summarized in At. Energ. (USSR); 26: 58-9(Jan 1969) as paper No. 258. (In Russian).

The use of local shielding for the strong radiation sources such as targets and certain machine parts in high energy accelerators is discussed. Local shielding can be used for the high-strength sources, and thus allow lesser requirements for the overall shielding for the accelerator assembly. (W.H.K.)

35771 EXPERIMENTAL INVESTIGATION OF DYNAMICS OF ELECTRON BEAM IN 1.5 GeV SYNCHROTRON. Vorob'ev, A. A.; Didenko, A. N.; Kozhevnikov, A. V. At. Energ. (USSR); 28: 260-3(Mar 1970). (In Russian).

Amplitudes of synchrotron and betatron oscillations and the influence of the synchrotron radiation on such oscillations were measured using a 1.5 GeV synchrotron. It was found that the quantum excitations of synchrotron oscillations prevail over their damping at 550 to 600 MeV energies and for radial betatron oscillations this effect takes place at somewhat higher energies (about 700 MeV). Data confirmed that at examined energies the quantum excitations of radial oscillations are not dangerous for normal electron acceleration operations while quantum excitations of phase oscillations could result in a great loss of accelerated electrons. The results of measurements confirmed the basic theoretical postulations considering radiation damping and quantum excitation of these oscillations. (R.V.J.)

35772 PULSE ANALYSIS SYSTEM FOR PHASE MEASUREMENTS ON THE INTERNAL BEAM OF AN ISOCHRONOUS CYCLOTRON. Reimann, Richard (Institut fuer Nuclearforschung, Zurich). Z. Angew. Math. Phys.; 20: 974-9(25 Nov 1969). (In German).

A calibration system designed to reproduce the selected signal at the terminal of a capacitive probe placed in the interior of an isochronous cyclotron is described. The calibration is done with the aid of a linear gate which is controlled by extremely narrow pulses and whose phase varies regularly between two limits. The frequency of these pulses is only a fraction of the frequency of the signal to be calibrated; this makes it possible to operate with a phase excursion which is equally a fraction of 2π. (tr-auth)

35773 QUANTAMETER WITH CONSTANT SENSITIVITY IN THE ENERGY RANGE 5 MeV TO 5 GeV (GAUSSIAN QUANTAMETER). Komar, A. P.; Kruglov, S. P.; Lopatin, I. V. (Ioffe Physical-Technical Inst., Leningrad). Nucl. Instrum. Methods; 82: 125-30(1970).

Description is given of a quantameter based on integration of the transition curve using the Gaussian quadrature formula with 6 abscissae. This permitted to achieve a constant sensitivity of the instrument in the $E_{\gamma max}$ range of 5 MeV to 5 GeV at a considerable simplification of its design. General formulae for theoretical calculation of the sensitivity of quantameters of any type are presented. The results of calculation for the "Gaussian quantameter" are compared with calorimetric measurement data. The instrument's sensitivity is shown not to change at a considerable change of the bremsstrahlung spectrum shape. (auth)

35774 COMPARISON OF A METHOD FOR MEASURING (n,xγ) CROSS SECTIONS USING A PULSED VAN DE GRAAFF ACCELERATOR WITH A METHOD USING AN ELECTRON LINAC. Dickens, J. K.; Perey, F. G. (Oak Ridge National Lab., Tenn.). Nucl. Instrum. Methods; 82: 301-3(1970).

Operating results for a system to measure (n,xγ) cross sections for E_n between 4 and 11 MeV using a pulsed Van de Graaff are presented. (auth)

35775 PHOTON ENERGY EMISSION FROM SPALLATION PRODUCTS PRODUCED BY 3 TO 13 GeV ELECTRONS. Wyckoff, James M. (National Bureau of Standards, Washington, D. C.). Health Phys.; 18: 693-704(Jun 1970).

A calculation of the energy emitted as photons from the ensemble of spallation products produced by a 3 to 13.3 GeV electron beam has been made. The time range of 1 hr to 50 months after irradiation is encompassed using measured production cross

sections for Al, Fe, Ni and Cu, major structural materials used around high energy particle accelerators. Similar calculations have been made for Mo, In, Ta and Pb by estimating production cross sections for some of the nuclides for which measured production cross sections were not available. Additional production cross sections measured for 3, 5 and 10 GeV electrons and comparisons with published 3 to 30 GeV proton spallation data are used to show the general applicability of the calculated decay curves. Graphs of the instantaneous irradiation case are included as well as some illustrative results for photon energy emitted following extended irradiation periods. (auth) (UK)

35776 STABILITY OF THE X-RAY BEAM FROM AN 8 MeV LINEAR ACCELERATOR DESIGNED FOR RADIOTHERAPY. Naylor, G. P.; Chiveralls, K. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Brit. J. Radiol.; 43: 414-19(Jun 1970).

A study was made of the stability of the x-ray beam from an 8 MV medical linear accelerator (M.E.L. Equipment Co. Ltd., type SL75 Super). The flatness of the beam and the intensity of the beam as measured by the built-in monitor were found to suffer small changes with gantry angulation and with time. Measurements were extended over a year during which the accelerator was in daily use for radiotherapy. The causes of the changes in the beam and the function of the stabilizing circuits which largely counteract such changes are outlined. The resulting complex system must be controlled by radiation measurements on the beam. Simple measuring jigs were made for the purpose and are described; they allow thimble ionization chambers to be accurately positioned in the beam during gantry angulation and for daily, weekly, and monthly checks. By routine use of these devices the changes of the beam were monitored and appropriate control adjustments made to the accelerator when necessary. The accuracy of the accelerator for radiotherapy purposes, when the techniques described were used for routine control, is examined and discussed. (auth) (UK)

35777 STABILIZATION SYSTEM OF THE CISE 8 MeV TANDEM VAN DE GRAAFF. Caruso, E.; Giorgetti, G.; Milazzo, M. (CISE, Milan). Energ. Nucl. (Milan); 17: 379-89(Jun 1970).

The stabilization system for the 8 MeV tandem Van de Graaff is reported. The stabilization is obtained with two regulating systems in parallel: the low frequency loop which corrects the sprayed current on the belt and the high frequency loop which controls, by a corrective signal, an electrode (liner) capacitively coupled to the accelerator terminal. (auth)

35778 CONTRIBUTIONS TO THE 3rd WORK MEETING ON ELECTRON RING ACCELERATORS, KARLSRUHE, GERMANY, OCTOBER 30–31, 1969. Karlsruhe, Ger.; Gesellschaft fuer Kernforschung mbH (1969). 210p. (CONF-691040).

Separate abstracts were prepared for 17 of the 18 papers presented. (W.H.K.)

For abstracts of individual papers see: 35779–35795.

35779 EVALUATION OF ERA RADIATION LOSS BY A PERTURBATION METHOD: SOME PRELIMINARY RESULTS. Moehl, D. (CERN, Geneva). 2p. of Contributions to the 3rd Work Meeting on Electron Ring Accelerators, Karlsruhe, Germany, October 30–31, 1969. Karlsruhe, Ger.; Gesellschaft fuer Kernforschung mbH (1969).

See CONF-691040.

The boundary value problem is solved by first considering a sinusoidal wave guide, i.e., a tube with its radius varying sinusoidally with Z. The radiation loss in more general structures is then obtained by Fourier analysis of the geometry. Conclusions from preliminary results from the simplified model of a cylinder (representing the ring) moving symmetrically between two corrugated plates are outlined. (W.H.K.)

35780 EXPERIENCES WITH GLASS PLATES IN BEAM DIAGNOSTIC. Galster, S. (Kernforschungszentrum, Karlsruhe, Ger.). 3p. of Contributions to the 3rd Work Meeting on Electron Ring Accelerators, Karlsruhe, Germany, October 30–31, 1969. Karlsruhe, Ger.; Gesellschaft fuer Kernforschung mbH (1969).

See CONF-691040.

Photoluminescent silver-activated phosphate glass plates were used to detect the beam profile and relative intensities of the first turn of electrons within the compressor of an electron-ring accelerator. The electron density distribution of a radiated glass plate behind an aluminum absorber is presented graphically. (W.H.K.)

35781 STABILITY OF ELECTRON RINGS IN CERAMIC COMPRESSOR CHAMBERS. Zotter, B. (CERN, Geneva). 4p. of Contributions to the 3rd Work Meeting on Electron Ring Accelerators, Karlsruhe, Germany, October 30–31, 1969. Karlsruhe, Ger.; Gesellschaft fuer Kernforschung mbH (1969).

See CONF-691040.

A theoretical study has been made on the stability of coherent oscillations of a beam of charged particles in a surrounding vacuum chamber consisting of an arbitrary number of layers of material such as ceramic or metal. Although the expressions are derived for a cylindrical beam in a concentric chamber, the results can also be used for a ring in a compression chamber when the distance from the ring to the wall is small compared to the ring diameter. The unexpected result of the analysis was the existence of dielectric resonances in a ceramic wall which increase the forces acting on the beam at certain frequencies by typically three orders of magnitude. (W.H.K.)

35782 STATUS REPORT OF THE KARLSRUHE ERA PROJECT. 4p. of Contributions to the 3rd Work Meeting on Electron Ring Accelerators, Karlsruhe, Germany, October 30–31, 1969. Karlsruhe, Ger.; Gesellschaft fuer Kernforschung mbH (1969).

See CONF-691040.

The experimental status of the electron-ring accelerator at Karlsruhe is outlined including the Febetron injector, the beam matching line, and the compressor. (W.H.K.)

35783 REMARKS ON CROSSING THE $Q_r = 1$ RESONANCE IN THE ELECTRON RING ACCELERATOR. van der Meer, S. (CERN, Geneva). 4p. of Contributions to the 3rd Work Meeting on Electron Ring Accelerators, Karlsruhe, Germany, October 30–31, 1969. Karlsruhe, Ger.; Gesellschaft fuer Kernforschung mbH (1969).

See CONF-691040.

When the rings are near maximum compression, ions are injected whose space charge effect will at a certain moment compensate the effect of the magnetic gradient, so that at that moment $Q_r = 1$. Depending on the density distribution, this resonance may be crossed for different parts of the cross section at different times. Classical reasoning about crossing a resonance is outlined, and its inapplicability to electron-ring accelerators discussed. (W.H.K.)

35784 RADIATION FROM RELATIVISTIC ELECTRON RINGS PASSING THROUGH CAVITIES. Lawson, J. D. (Rutherford High Energy Lab., Chilton, Eng.). 4p. of Contributions to the 3rd Work Meeting on Electron Ring Accelerators, Karlsruhe, Germany, October 30–31, 1969. Karlsruhe, Ger.; Gesellschaft fuer Kernforschung mbH (1969).

See CONF-691040.

Data on radiation losses from relativistic electron rings passing through cavities are presented. Tables of calculations in cylindrical geometry are presented for a single cavity, an infinite array of cavities with a point charge, and an infinite array of cavities with a ring charge. Also, a table of calculations for an infinite planar system is given. Authors and references of each calculation are tabulated. (13 references). (W.H.K.)

35785 COMPARISON BETWEEN LASER ELECTRON SOURCE AND FEBETRON. Andelfinger, C.; Buchelt, E.; Ott, W.; Siller, G. (Institut fuer Plasmaphysik, Garching, Ger.). 5p. of Contributions to the 3rd Work Meeting on Electron Ring Accelerators, Karlsruhe, Germany, October 30–31, 1969. Karlsruhe, Ger.; Gesellschaft fuer Kernforschung mbH (1969).

See CONF-691040.

It is stated that the Febetron electron source failed to meet the requirements for an electron-ring accelerator source, and preliminary results in the development of a laser electron source are presented. A laser beam was focused on a metal surface to liberate an electron beam of high brightness. (W.H.K.)

35786 ACCELERATED HEAVY IONS AT HIGH DUTY CYCLE BY ASSOCIATION OF A SMOKATRON WITH A CIRCULAR DUTY CYCLE STRETCHER. Bruck, H. (CEN, Saclay, France). 6p. of Contributions to the 3rd Work Meeting on Electron Ring Accelerators, Karlsruhe, Germany, October 30–31, 1969. Karlsruhe, Ger.; Gesellschaft fuer Kernforschung mbH (1969).

See CONF-691040.

An order-of-magnitude evaluation of the possibility of using a storage ring to stretch the duty cycle of an electron-ring accelerator for acceleration of heavy ions is presented. (W.H.K.)

35787 STATUS REPORT ON ELECTRON RING EXPERIMENTS IN GARCHING. Andelfinger, C.; Herrmann, W.; Merkel, P.; Ott, W.; Schlueter, A.; Schumacher, U.; Ulrich, M.; Welter, H. (Institut fuer Plasmaphysik GmbH, Garching, Ger.). 6p. of Contributions to the 3rd Work Meeting on Electron Ring Accelerators, Karlsruhe, Germany, October 30–31, 1969. Karlsruhe, Ger.; Gesellschaft fuer Kernforschung mbH (1969).

See CONF-691040.

The Garching electron ring experiment attempts to compress the electron ring by one order of magnitude faster (20 μs) than at other laboratories. The advantages of this faster compression are lower requirements on the vacuum system and faster crossing of magnetic field regions, where instabilities could grow and destroy the ring. The electron gun, beam transport system, and compressor are briefly described, and measurements of the ring current and its time behavior, using a Faraday cup, are presented. (W.H.K.)

35788 KARLSRUHE COMPRESSOR. Kappe, Peter (Institut fuer Experimentelle Kernphysik, Karlsruhe, Ger.). 8p. of Contributions to the 3rd Work Meeting on Electron Ring Accelerators, Karlsruhe, Germany, October 30–31, 1969. Karlsruhe, Ger.; Gesellschaft fuer Kernforschung mbH (1969).
See CONF-691040.

Main parameters of the Karlsruhe compressor and construction details are discussed. Compression time and tolerances and field measurements are included. (W.H.K.)

35789 IS THE ELECTRON RING ACCELERATOR (ERA) USEFUL FOR THE ACCELERATION OF HEAVY IONS. Schopper, H. (Gesellschaft fuer Kernforschung mbH, Karlsruhe, Ger.). 9p. of Contributions to the 3rd Work Meeting on Electron Ring Accelerators, Karlsruhe, Germany, October 30–31, 1969. Karlsruhe, Ger.; Gesellschaft fuer Kernforschung mbH (1969).
See CONF-691040.

Performance capabilities of the electron-ring accelerators for accelerating heavy ions are discussed. The energy-intensity relation, energy spread, and length of the accelerator are considered. It is concluded that the electron-ring accelerator could be very useful for the acceleration of heavy ions. (W.H.K.)

35790 THEORETICAL ASPECTS OF INFLECTION. Steinbock, L. (Kernfornschungszentrum, Karlsruhe, Ger.). 9p. of Contributions to the 3rd Work Meeting on Electron Ring Accelerators, Karlsruhe, Germany, October 30–31, 1969. Karlsruhe, Ger.; Gesellschaft fuer Kernforschung mbH (1969).
See CONF-691040.

The problem of electron inflection into the compressor of an electron-ring accelerator is studied. The inflector magnetic field is produced by separate inflector bars located close to the equilibrium orbit. Compressor admittance and emittance matching is discussed. (W.H.K.)

35791 ION INJECTOR FOR THE SMOKATRON. Dommaschk, W. (Institut fuer Plasmaphysik GmbH, Garching, Ger.). 10p. of Contributions to the 3rd Work Meeting on Electron Ring Accelerators, Karlsruhe, Germany, October 30–31, 1969. Karlsruhe, Ger.; Gesellschaft fuer Kernforschung mbH (1969).
See CONF-691040.

The development of an ion injection system for an electron-ring accelerator is described. This injection system is being designed to generate an ion ring so that the electrons can be injected into the ion ring before compression begins. This injection method is hoped to overcome some of the disadvantages of ion injection after electron ring compression. The duoplasmatron ion source, beam focusing system, and beam inflecting system are described. Beam emittance measurements and calculation of beam spread and losses in the injector are discussed. (W.H.K.)

35792 EXPERIENCES WITH THE FEBETRON. Dustmann, C. H. (Institut fuer Experimentelle Kernphysik, Karlsruhe, Ger.). 10p. of Contributions to the 3rd Work Meeting on Electron Ring Accelerators, Karlsruhe, Germany, October 30–31, 1969. Karlsruhe, Ger.; Gesellschaft fuer Kernforschung mbH (1969).
See CONF-691040.

As an injector for an electron-ring accelerator a commercial accelerator (Febetron) with a field emission cathode is used. In a series of measurements, the characteristic properties of the Febetron have been determined in order to be able to use the injector in the most profitable way for an ERA. (auth)

35793 ENERGY LOSS OF A CHARGED RING PASSING A CORRUGATED CYLINDRICAL WAVEGUIDE. Keil, E. (CERN, Geneva). 12p. of Contributions to the 3rd Work Meeting on Electron Ring Accelerators, Karlsruhe, Germany, October 30–31, 1969. Karlsruhe, Ger.; Gesellschaft fuer Kernforschung mbH (1969).
See CONF-691040.

Field expansion into Fourier series and matching of all field components at the common boundary surface are shown to be a suitable method for calculating the energy radiated by electrons traveling in a cylindrical corrugated wave guide. This method is limited to wavelengths longer than a few millimeters for reasons of computer time. The energy losses are calculated for several wave guide dimensions and compared with published results for one particular set of wave guide dimensions. The electron ring dimensions and their velocity have no significant influence on the energy loss. (W.H.K.)

35794 ENERGY LOSS OF CHARGED BUNCHES IN A CORRUGATED CYLINDRICAL WAVEGUIDE. II. COMPARISON WITH VARIOUS MODELS. Keil, E. (CERN, Geneva). 19p. of Contributions to the 3rd Work Meeting on Electron Ring Accelerators, Karlsruhe, Germany, October 30–31, 1969. Karlsruhe, Ger.; Gesellschaft fuer Kernforschung mbH (1969).
See CONF-691040.

The method for calculating the energy loss of charge distributions traveling along a corrugated cylindrical wave guide is described in the companion paper I. Computational results are compared with two analytical formulae for the energy loss of point charges traveling along the axis of the wave guide. (W.H.K.)

35795 STATUS REPORT ON THE ERA EXPERIMENT AT UC-BERKELEY AND -LIVERMORE. Luccio, A. U. (Univ. of California, Berkeley. Univ., Milan). 19p. of Contributions to the 3rd Work Meeting on Electron Ring Accelerators, Karlsruhe, Germany, October 30–31, 1969. Karlsruhe, Ger.; Gesellschaft fuer Kernforschung mbH (1969).
See CONF-691040.

Compressor III is described including the new coil design and coil circuits. The dynamical behavior of Compressor III is described graphically. The diagnostic equipment including pickup coils, moveable probes, and radiation detectors are discussed. A computer program OPERA for calculating the dynamical behavior of the ring and circuit equations on-line with the experiment is described. Electron injection, ring compression and roll out, and ion trapping are shown diagrammatically. (W.H.K.)

PHYSICS (NUCLEAR)

Neutron Interactions with Matter

Refer also to abstracts 33934 and 35525.

35796 (AD-701757) ENDT: A FORTRAN PROGRAM TO PREPARE CROSS-SECTION DATA FOR UNC-SAM-3 FROM ENDF/B TAPES. Final Report. Kellman, S. (United Nuclear Corp., Elmsford, N. Y. Research and Engineering Center). Jan 1970. Contract DASA01-69-C-0021. 56p. (UNC-5243; DASA-2337). CFSTI.

With the establishment of the Cross Section Evaluation Center at Brookhaven National Laboratory, more detailed, evaluated cross section information has become available, permitting more accurate analysis of problems of interest. In order to make use of this wealth of information in the UNC-SAM-3 Monte Carlo code, the ENDT program, generating an element data tape for later use in UNC-SAM-3 has been written. The present version of the code addresses itself to its use in generating the data required for shielding calculations and takes into consideration the accuracy of today's measurements. ENDT reads the Evaluated Nuclear Data File and calculates total, total scattering, and inelastic cross sections, and establishes the tables required to treat the angular distribution of neutrons emerging from elastic scattering collisions and the energy distribution of those emerging from inelastic scattering collisions. The code permits Doppler broadening in the resolved resonance range but in the present version no attempt has been made to extend the treatment to all energies since the effect has little significance in shielding calculations. The report tries to document the treatment of the cross section and distribution data, stating explicitly the assumptions made. The FORTRAN listing of the code contains numerous comment cards which should be helpful to a programmer going through the code, and should facilitate the alteration of the code to suit the needs of a given installation. (auth) (USGRDR)

35797 (AD-701758) MODIFICATION OF UNC-SAM-2 TO UNC-SAM-3. Final Report. Troubetzkoy, E. S. (United Nuclear Corp., Elmsford, N. Y. Research and Engineering Center). Jan 1970. Contract DASA01-69-C-0021. 33p. (UNC-5157(Suppl.1); DASA-2338). CFSTI.

The document is a supplement to AD-647 470 and describes the changes in the UNC-SAM-2 programs which have been made to accommodate a revised cross section format. The modified program has been designated UNC-SAM-3. (auth) (USGRDR)

35798 THE FOURIER TRANSFORM OF A PRODUCT OF TWO SPHERICAL BESSEL FUNCTIONS. Kschwendt, Heinz (EURATOM, Ispra, Italy). Atomkernenergie; 15: 122-6(1970).

The application of the j_N-method to neutron transport in slabs and spheres involves the determination of the Fourier transform of a product of two spherical Bessel functions. Depending on the argument, the result is either a special polynomial or zero. Recurrence formulas for arbitrary indices of the spherical Bessel functions are obtained and properties connected with integrals on the above polynomials are derived. The method is extended to a more general integral. As a by-product, a relation between Legendre polynomials was discovered. These results allow an elementary determination of the matrix elements, which appear in the application of the j_N-method. (auth)

35799 THERMAL NEUTRON DIFFRACTION. Willis, B. T. M. (ed.). Harwell Post-Graduate Series. Oxford; Oxford University Press (1970). 229p. 65s.

Accurate measurements of the intensities of elastically scattered neutrons are described in three parts. Part A deals with experimental methods, including the procedures for correcting the experimental measurements for the many possible sources of systematic error. Part B is concerned with diffraction studies in which the neutrons are scattered by the atomic nucleus, and Part C with studies involving the scattering of neutrons by unpaired electrons in the atom. (UK)

35800 NEUTRON FLUX DENSITY FOR THE DISK TARGET OF A NEUTRON GENERATOR. Croitoru, P. (Inst. for Atomic Physics, Bucharest). Rev. Roum. Phys.; 14: 1001-10(1969).

The calculation procedure is described for the neutron flux density in a certain point situated in the neighborhood of the target. The notion of irradiation yield is introduced, with the aid of which the target diameters to the sample volumes have to be correlated, in order to obtain an increased efficiency of the irradiation. (auth)

35801 SCATTERING OF LONG-WAVELENGTH NEUTRONS BY NEUTRON-IRRADIATED MAGNESIUM OXIDE. Sabine, T. M.; Svenson, A. C. (Australian Atomic Energy Commission Research Establishment, Lucas Heights, N. S. W.). J. Phys., C (London); 3: 86-9(Jan 1970).

Measurements of the increase in the total cross section of magnesium oxide for long wavelength neutrons (6-12 Å) have shown that at low doses ($<10^{20}$ n.v.t.) the defects shown by this technique are clusters no larger than defect pairs. At higher doses, larger defects are formed whose scattering pattern can be adequately described by a model in which the defect cluster is a cube of four magnesium and four oxygen atoms at the normal MgO spacing. (auth) (UK)

35802 INFLUENCE OF A DIFFUSIVE MODERATOR ON THE INTENSITY OF A Pu-Be SOURCE. Capgras, A. (CEN, Saclay, France). Nucl. Instrum. Methods; 82: 7-12(1970). (In French).

The author made an attempt to determine the effect of a moderator such as water on the neutron density of a Pu-Be source measured by the manganese bath method. It was found that the correction factor is of about 1.5% for the L.M.R. standard source whose neutron emission is 10^7 n/s·4π approximately. This factor grows according to the quantity of plutonium in the source. (auth)

35803 GAMMA TO NEUTRON RATIOS FOR Pu-Be AND Am-Be NEUTRON SOURCES. Venkataraman, G.; Dayashankar; Jayakar, J. S. (Bhabha Atomic Research Centre, Bombay). Nucl. Instrum. Methods; 82: 49-50(1970).

Because of the surprising extent of discrepancy that exists in literature on values for the gamma to neutron ratio for Pu-Be neutron sources and because of the absence of similar data for Am-Be neutron sources, these ratios were determined experimentally by measuring the gamma-ray spectra of the sources. The values of the ratios were also calculated using recent cross section data. The measured values were found to be in good agreement with the calculated values. A relatively simple method for measuring the neutron yields of these sources is suggested. (auth)

35804 ASYMMETRIC SPIN-ORBIT EFFECTS CALCULATED FOR THE TOTAL REFLECTION OF POLARIZED COLD NEUTRONS. Handel, P. H. (Univ. of Missouri, St. Louis). Phys. Rev. Lett.; 24: 835-7(13 Apr 1970).

Strange asymmetries observed in magnetic neutron guides are explained in terms of an additional surface current due to the spin-orbit interaction of the neutrons in the Coulomb field of the atoms. This result enhances the approach of the index of refraction for the total reflection of neutrons using the propagator of the Schroedinger equation. (auth)

35805 ITERATIVE METHOD FOR SOLVING THE NEUTRON TRANSPORT EQUATION IN x-y GEOMETRY. Davis, J. A.; Hageman, L. A. (Bettis Atomic Power Lab., West Mifflin, Pa.). SIAM (Soc. Ind. Appl. Math.) J. Appl. Math.; 17: 149-61(Jan 1969). (WAPD-T-2088).

An iterative method is formulated and analyzed for the transport equations and the associated discrete equations. The convergence of the method for a class of neutron transport problems is established. It is shown that the eigenvalues of the iteration error operator are real under certain circumstances. This fact is useful in applying the Chebyshev polynomial or the successive overrelaxation method to accelerate the convergence rate of the basic iterative process. (J.W.R.)

35806 NEUTRON SPECTRUM OF THE RADIOACTIVE Be(α,n) SOURCE IN THE ENERGY REGION ABOVE 1 MeV. Kluge, H. (Physikalisch-Technische Bundesanstalt, Brunswick). Z. Naturforsch., 24a: 1289-90(Aug. 1969). (In German).

Neutron spectrum above 1 MeV was determined for ^{241}Am-^{9}Be(α,n) and ^{226}Ra-^{9}Be(α,n) sources. The method involves energy measurements of recoil protons from thin polyethylene foils. The recoil protons penetrate two proportional counters and the energy is then measured with a silicon semiconductor all of which are operated in coincidence. The proportional counters contain a mixture of Ar and carbon dioxide. Diagrams of the experimental setup and of the observed spectra are presented. (H.B.G.)

Nuclear Properties and Reactions, A≤5

Refer also to abstract 35927.

35807 (EUR-4456) DATA REDUCTION PROGRAMS FOR TOTAL CROSS SECTION EXPERIMENTS. Nastri, G.; Schmid, H. (European Atomic Energy Community, Geel (Belgium). Central Nuclear Measurements Bureau). 18 Nov 1969. 62p. Dep. CFSTI (U. S. Sales Only). EUR FF 9.45.

The present set of data reduction programs (FORTRAN IV, IBM 1800 computer) calculates the transmission and the total neutron cross section for time-of-flight measurements. Dead time and background corrections are performed and the statistical fluctuations of the experimental spectrum for the open beam are eliminated. The reduced data can be plotted. (auth)

35808 (KAPL-P-3844) NEUTRON CROSS SECTION. Conrad, C. A. (Knolls Atomic Power Lab., Schenectady, N. Y.). 13 Nov 1969. 9p. Dep. CFSTI.

The neutron cross section and its experimental determination are discussed. The standard methods of analysis used at most laboratories for low and intermediate energy resonance are presented. (L.W.A.)

35809 MASS SPECTROMETRIC DETERMINATION OF THE MASS DIFFERENCE H_2–D AND THE STABLE ISOTOPIC MASSES AND MASS DIFFERENCES OF SAMARIUM, EUROPIUM, GADOLINIUM, TERBIUM, AND DYSPROSIUM. Hudson, Marshall Clyde. Minneapolis; Univ. of Minnesota (1969). 73p.

Thesis.

The 16-inch, double focusing mass spectrometer at the University of Minnesota was used to measure the atomic mass difference H_2–D by employing the $C_6H_{12}^+$ ion from 2-hexene and the $C_6D_2^+$ ion from deuterated benzene. The measured mass difference H_2–D is 1548.22 ± .05 μu. The isotopic mass differences of most of the stable isotopes from samarium to dysprosium together with mass doublets linking one element to another were measured. In addition several different hydrocarbon to metal doublets were measured in order to determine the absolute masses of the metals with respect to these hydrocarbon substandards. Nuclear reaction Q-values, α decay, and β decay energies were combined with these measurements in order to calculate the masses and mass differences of forty radioactive isotopes in the same mass region. This composite of masses and mass differences is used to show the systematic behavior and some unusual features of the mass surface in this region. Certain quantities which are sensitive to nuclear structure were calculated and plotted for the nuclei under investigation. These quantities are the following: neutron separation energy, separation energy of the last two neutrons, neutron pairing energy, proton separation energy, separation energy of the last two protons, and the proton pairing energy. The striking feature demonstrated by these quantities is a relative maximum in neutron binding and pairing energies when the neutron number is about 90. This represents a distinct change from the normal behavior of nuclides at other mass numbers. It is believed that the onset of nuclear deformation is responsible for this behavior. The proton separation energies, however, do not show appreciable departure from the expected systematics in this region. (Diss. Abstr. Int., B)

35810 PION-NUCLEON SCATTERING WITH VENEZIANO TERMS. Fenster, S.; Wali, Kameshwar C. (Argonne National Lab., Ill.). Phys. Rev., D; 1: 1409-16(1 Mar 1970).

A crossing-symmetric pion-nucleon scattering amplitude with Regge behavior is constructed using suitable combinations of beta-function terms. Observed spins, isospins, and widths of resonances in a limited low-energy region are enforced, and the Regge residue functions for high-energy scattering are obtained in terms of these resonance parameters. Forward charge exchange and backward elastic differential cross sections are compared with experiment, and a version of ρ universality is checked. (auth)

35811 ^{3}He POLARIZATION MEASUREMENTS AND PHASE SHIFTS FOR p-^{3}He ELASTIC SCATTERING. McSherry, D. H.; Baker, S. D. (Rice Univ., Houston, Tex.). Phys. Rev., C; 1: 888-92(Mar 1970).

Further measurements for the elastic scattering of protons by polarized ^{3}He in the 4 to 11-MeV range are reported. A phase-shift analysis based on cross-section, polarization, and spin-correlation data is presented, and the precision with which some of the parameters are determined is discussed. (auth)

35812 POLARIZATION IN n-d SCATTERING AT 7.8 MeV. Taylor, J.; Spalek, G.; Stammbach, Th.; Hardekopf, R. A.; Walter, R. L. (Duke Univ., Durham, N. C. Triangle Universities Nuclear Lab., Durham, N. C.). Phys. Rev., C; 1: 803-8(Mar 1970).

Asymmetries produced in the scattering of 7.8-MeV polarized neutrons are measured to an accuracy better than ±0.020 for 12 angles ranging from 58° to 165° (c.m.). The ^{9}Be(α,n_0) reaction is employed as a neutron source with a polarization of 0.539 ± 0.012. The measured asymmetries agree with the 8-MeV data for the charge-symmetric p-d scattering, indicating that the Coulomb effects are indeed small at this energy. The data also follow the trend of the 9-MeV calculation of Purrington and Gammel. (auth)

35813 INVESTIGATIONS OF THE FIRST EXCITED STATE OF ^{4}He VIA THE REACTION ^{7}Li(p,α). Lin, Wen-kuan; Scheibling, F.; Kavanagh, R. W. (California Inst. of Tech., Pasadena). Phys. Rev., C; 1: 816-24(Mar 1970).

The α-particle energy spectra from bombardment of ^{7}Li with 9.1-MeV protons are obtained for $2.5° \leq \theta_\alpha \leq 120°$. The high-energy portions of the α spectra are interpreted as due to the ^{1}S, p + ^{3}H final-state interaction through the first excited state of ^{4}He at 20.06 MeV. The factored-wave-function method is used to deduce the resonance parameters of this state. Consistency in the use of this method is obtained by a plane-wave Born-approximation calculation based on triton-transfer mechanisms to account for the forward peaking in the angular distribution. Coincidence measurements between α particles and other charged reaction products give additional evidence for the 0^+ assignment to the state and indicate the importance of the α + ^{3}H and α + ^{1}H final-state interactions at still higher excitation energy of the ^{4}He system. (auth)

Nuclear Properties and Reactions, 6≤A≤19

Refer also to abstracts 35807, 35808, 35813, 35912, and 35926.

35814 EXCITATION OF THE ONE-NUCLEON CONTINUUM OF ^{12}C BY ELECTRON SCATTERING AT LOW MOMENTUM TRANSFER. Antony-Spies, P. (Univ., Frankfurt am Main); Delsanto, P. P.; Spamer, E.; Goldmann, A.; Titze, O. Phys. Lett., 31B: 632-4(11 May 1970).

Inelastic electron scattering cross sections are calculated for excitation energies above the one-particle threshold in ^{12}C. The nuclear problem has been treated in the framework of the eigenchannel theory of nuclear reactions using the 1p-1h-approximation. The treatment of the electron is restricted to first order Born approximation. The numerical results obtained for negative parity states up to $J^\pi = 4^-$ are presented together with new experimental data from the Darmstadt Linac. (auth)

35815 PARITY-FORBIDDEN ALPHA DECAY FROM THE 2^- (8.88 MeV) LEVEL IN ^{16}O. Gari, M. (Ruhr Univ., Bochum, Ger.). Phys. Lett., 31B: 627-31(11 May 1970).

On the example of the alpha decay from the 2^- (8.88 MeV) level in ^{16}O the theory of parity nonconserving alpha decay is used to discuss various weak nucleon–nucleon potentials in comparison with the experimental value ($\Gamma_\alpha^{2^-} = (2 \pm 1)\ 10^{-10}$ eV) found by Wiffler et al. The influence of the hard core has been studied by using solutions of the Bethe–Goldstone equation for finite nuclei. (auth)

35816 QUASIELASTIC SCATTERING OF ^{6}Li IONS DETERMINED BY THE CHARGE-EXCHANGE SPIN-FLIP FORCES. Chuev, V. I.; Davydov, V. V.; Manko, V. I.; Novatskii, B. G.; Sakuta, S. B.; Stepanov, D. N. (Inst. of Atomic Energy, Moscow). Phys. Lett., 31B: 624-6(11 May 1970).

The quasielastic scattering of ^{6}Li ions, determined by the $(\tau_1\tau_2)(\sigma_1\sigma_2)$ forces in the nucleon–nucleon interaction, is considered. The experimental results on the ^{12}C(^{6}Li,^{4}He)^{13}N and ^{9}Be(^{6}Li,^{8}He)^{7}B reactions, which appear to prove that these reactions are such quasielastic scattering processes, are presented. (auth)

35817 THE DYNAMICS OF THREE α-PARTICLE DECAY FROM AN UNPOLARIZED SOURCE. Cockburn, P. M.; Goldfarb, L. J. B.; Grant, I. S.; Reed, H. E. (Univ. of Manchester, Eng.). Nucl. Phys.; A141: 532-50(1970).

The reaction ^{11}B(p,αα)α was investigated at a proton energy of 680 keV. At this energy the compound nucleus is unpolarized, and the experimental data can be displayed on the Dalitz plot of the three α-particle system. A theoretical analysis of the Dalitz plot was made, based on the level parameters of ^{8}Be, and including the effects of the interference arising from the identity of the α-particles. The level parameters giving the best fit are in agreement with those derived from αα scattering. The results are suggestive of a rescattering phenomenon with distorts a limited region of the Dalitz plot. (auth)

35818 ANALYSIS OF THE HIGH-ENERGY PHOTONUCLEON EMISSION FROM ^{16}O AND ^{12}C IN A DIRECT REACTION MODEL. Mustafa, M. G. (Yale Univ., New Haven); Malik, F. B. Contract AT(30-1)-2726. Phys. Rev., C; 1: 753-62(Mar 1970).

High-energy photonucleon emission probabilities in ^{16}O and ^{12}C are studied by (a) the standard direct-emission model and (b) the standard direct-emission model modified to incorporate the ground-state correlation. The calculation is made for the 90° differential cross section, integrated cross section, angular distributions at a few energies, and 45° polarization. Inclusion of the ground-state correlation improves the agreement between the theoretical results and the observations. This, along with the sensitivity of the absolute magnitude of the photonucleon cross section to the extent of the correlation, may be exploited to study the composition of the wave functions of the target and the residual nucleus. (auth)

35819 POLARIZATION OF NEUTRONS FROM THE $^{9}Be(d,n)^{10}B$ REACTION WITH 0.9- TO 2.48-MeV DEUTERONS. Miller, T. G. (Army Missile Command, Redstone Arsenal, Ala.); Biggerstaff, J. A. Phys. Rev., C; 1: 763-8(Mar 1970).

Three polarization distributions over the angular range from 15° to 135° (lab) are obtained for neutrons produced in the $^{9}Be(d,n)^{10}B$ reaction. Polarization distributions are obtained for deuteron bombarding energies of 1.56, 2.064, and 2.48 MeV. Polarization measurements are made for up to five neutron groups corresponding to transitions to the ground- and the 0.72-, 1.74-, 2.15-, and 3.58-MeV states of ^{10}B. A liquid-helium time-of-flight coincidence neutron polarimeter is used to make the measurements. In general, the polarization of the neutrons from the ground state is negative at forward angles and positive at back angles for deuteron bombarding energies from 1.56 to 2.48 MeV, whereas the polarization of the neutrons from the excited states is positive for forward angles and negative for back angles, the exception being neutrons from the 1.74-MeV level in ^{10}B. The maximum polarization observed is about 35%. (auth)

35820 ELECTRIC QUADRUPOLE MOMENT OF THE SHORT-LIVED BETA-EMITTER ^{12}B. Sugimoto, K.; Mizobuchi, A.; Matuda, K.; Minamisono, T. (Osaka Univ.). Phys. Lett.; 31B: 520-2(13 Apr 1970).

Quadrupole effects in NMR on polarized ^{12}B produced and implanted in polycrystalline TiB_2 and ZrB_2 through a nuclear reaction are observed, with the results of $eqQ/h = 154 \pm 16$ kHz and 49 ± 5 kHz, respectively. Comparison with the known values for ^{11}B yields $|Q(^{12}B)/Q(^{11}B)| = 0.42 \pm 0.04$. (auth)

35821 $^{10}Be(d,p)^{11}Be$ AND THE $^{10}Be(d,\alpha)^{8}Li$ REACTIONS. Goosman, D. R.; Kavanagh, R. W. (California Inst. of Tech., Pasadena). Phys. Rev., C; 1: 1939-45(Jun 1970).

Beryllium enriched to 5% in ^{10}Be is extracted from neutron-irradiated carbon, and is used for targets in nuclear spectroscopy. The cross section for the production of ^{8}Li via deuteron bombardment of ^{10}Be is measured from 0.67 to 3.0 MeV, and the production cross section of ^{11}Be is measured from 2.3 to 12 MeV. The yield for both reactions varies smoothly with bombarding energy, and no resonance in ^{12}B is seen. From magnetic spectroscopy of the $^{10}Be(d,p)$ reaction, the mass excess of ^{11}Be is found to be 20.174 ± 0.007 MeV ($^{12}C = 0$) and the excitation energy of the first excited level to be 318 ± 7 keV. The angular distribution of protons populating the 318-keV level is an $l_n = 1$ pattern, implying $J^\pi = \frac{1}{2}^-$ or $\frac{3}{2}^-$. (auth)

35822 CALCULATION OF THE NEUTRON SPECTRA FROM PROTON-NUCLEUS NONELASTIC COLLISIONS IN THE ENERGY RANGE 15 TO 18 MeV AND COMPARISON WITH EXPERIMENT. Alsmiller, R. G. Jr. (Oak Ridge National Lab., Tenn.); Hermann, O. W. Nucl. Sci. Eng.; 40: 254-61(May 1970).

The energy distribution of neutrons from proton-nucleus nonelastic collisions for 18-MeV protons on ^{14}N, ^{27}Al, ^{56}Fe, ^{181}Ta, and ^{208}Pb and for 15-MeV protons on ^{27}Al and ^{208}Pb were calculated with the intranuclear-cascade-evaporation model of nuclear reactions and with the evaporation model of nuclear reactions. Comparisons between the calculated neutron spectra and experimental data are presented, and it is shown that neither model is entirely reliable in the energy region considered but that the intranuclear-cascade-evaporation model is the more reliable of the two. (auth)

35823 GAMMA-RAY-PRODUCTION CROSS SECTIONS FOR FAST NEUTRON INTERACTIONS WITH SEVERAL ELEMENTS. Drake, Darrell M. (Los Alamos Scientific Lab., N. Mex.); Hopkins, John C.; Young, C. S.; Conde, H. Nucl. Sci. Eng.; 40: 294-305(May 1970).

The differential cross sections for the production of gamma radiation from fast-neutron inelastic scattering have been measured at incident neutron energies from 4.00 to 7.67 MeV for Be, C, O, Al, Si, Fe, Ni, Nb, W, and ^{239}Pu. The gamma-ray spectra were measured with a NaI(Tl) spectrometer using time-of-flight techniques to eliminate the neutron background. The gamma-ray detector was surrounded with a large NaI(Tl) annulus operated in the anticoincidence mode. The resulting spectra were unfolded and appropriate corrections were applied for neutron and gamma-ray attenuation, for electronic dead time, and for detector efficiency. (auth)

35824 INVESTIGATION OF NUCLEAR LEVELS BELOW 16 MeV IN ^{12}C BY INELASTIC ELECTRON SCATTERING. Wittwer, G.; Clerc, H.-G; Beer, G. A. (Technische Hochschule, Darmstadt, Ger.). Z. Phys.; 234: 120-43(1970). (In German).

Spectra of electrons scattered from a 91.7% enriched ^{12}C target were measured for primary energies between 36 and 65 MeV and scattering angles between 105 and 165°. For levels at 3.08, 3.69, 6.85, 7.54, 8.86, 9.90, 11.07, 11.80 and 15.11 MeV excitation energy, partial ground state radiative widths or monopole matrix elements, respectively, and transition radii were obtained. Corrections from DWBA calculations were incorporated in the analysis. The excitation of levels at 3.85, 7.68, 7.83 and 10.86 MeV was also observed. (auth)

35825 SPIN-ORBIT COUPLING EFFECTS IN DEUTERON STRIPPING ANGULAR CORRELATIONS. Tepel, J. W. (South African Atomic Energy Board, Pelindaba). Z. Phys.; 234: 107-11(1970).

Spin-orbit contributions in the DWBA analysis of particle-gamma angular correlations following deuteron stripping reactions were investigated for several $l = 2$ transitions. It is shown that in general these effects are quite large. (auth)

35826 THE $^{16}O(n,x\gamma)$ REACTION FOR $6.7 \leq E_n \leq 11$ MeV. Dickens, J. K.; Perey, F. G. (Oak Ridge National Lab., Tenn.). Nucl. Sci. Eng.; 40: 283-93(May 1970).

Gamma-ray spectra were obtained for the reactions $^{16}O(n,n'\gamma)^{16}O$ and $^{16}O(n,\alpha\gamma)^{13}C$ for incident-mean-neutron energies E_n between 6.7 and 11.0 MeV. The gamma rays were detected using a 30 cm³ coaxial Ge(Li) detector placed at 55 and 90 deg with respect to the incident-neutron direction. Time-of-flight electronics was used with the gamma-ray detector to discriminate against unwanted pulses due to neutrons and background gamma radiation. Two samples of 75 and 31 gm of BeO in the form of right circular cylinders were used. The incident-neutron beam was produced by bombarding a deuterium-filled gas cell with a pulsed deuteron beam of appropriate energy; for $E_n \leq 8.5$ MeV the deuteron beam was obtained from the ORNL 6-MV Van de Graaff, and for $E_n \geq 8.5$ MeV it was obtained from the ORNL Tandem Van de Graaff. These data were reduced to differential cross sections for production of gamma rays from ^{16}O. The cross sections were compared, where possible, with previously measured values with reasonable agreement. However, there are several important differences, and these are discussed. Summing the partial cross sections yields values for the total nonelastic cross section which are in good agreement with values for the nonelastic cross section obtained from the difference between the total cross section and the total elastic cross section. (auth)

35827 THE $^{14}N(n,x\gamma)$ REACTION FOR $8.5 \leq E_n$ 11 MeV. Dickens, J. K.; Perey, F. G. (Oak Ridge National Lab., Tenn.). Nucl. Sci. Eng.; 40: 346-8(May 1970).

Differential γ-production cross sections for $^{14}N(n,x\gamma)$ reactions at 8.5 to 11 MeV are reported. The data are compared with some previous results. (J.W.R.)

35828 INFORMATION ON SHORT-RANGE NUCLEON-NUCLEON CORRELATIONS AND WOODS-SAXON NUCLEAR POTENTIAL FROM HIGH-ENERGY ELASTIC ELECTRON SCATTERING. Ciofi Degli Atti, C.; Kabachnik, N. M. (Istituto Superiore di Sanita, Rome. Istituto Nazionale di Fisica Nucleare, Rome). Phys. Rev., C; 1: 809-15(Mar 1970).

A method is developed which allows the effect of the short-range dynamical correlations on the nuclear-charge form factors generated in arbitrary potential wells to be taken into account. Recent high-energy experimental data on elastic electron scattering by ^{6}Li, ^{12}C, and ^{16}O are analyzed with this method. The single-particle radial wave functions are generated in a state-dependent Woods–Saxon well whose parameters are chosen to fit the eigenenergies to the proton separation energies, as obtained from (p,2p) reactions. It is shown that only by the inclusion of correlations is it possible to reproduce theoretically the experimental charge form factor of ^{6}Li and ^{16}O nuclei. It is also pointed out that the inclusion of correlations leads to the use of potential wells which are deeper and narrower than usually assumed. The radial wave functions of the harmonic oscillator are also used. It is shown that these wave functions also give a good reproduction of the

experimental data, provided that correlations are taken into account. The effect of the center-of-mass motion on the form factors calculated in the finite well is also considered. (auth)

35829 EXCITATION OF T = 1 PARTICLE-HOLE STATES IN ^{12}C BY INELASTIC ELECTRON SCATTERING. Donnelly, T. W. (Stanford Univ., Calif.). Phys. Rev., C; 1: 833-46(Mar 1970).

The T = 1 single-particle-hole states of ^{12}C are considered on the basis of the harmonic-oscillator shell model in the particle-hole formalism developed by Lewis and Walecka. Configuration mixing is included via a Serber–Yukawa residual interaction. Resulting mixed states lying close in energy are grouped together into complexes whose inelastic-electron-scattering form factors are then compared with recent experimental data. This comparison is done mainly at large momentum transfers and large scattering angles, where the transverse excitations (and consequently the T = 1 states) dominate, and where the excitation spectrum contains only a few strongly excited features (to be related here to collective single-particle-hole states). By working at high momentum transfer, the contributions from transitions of high multipolarity can be strongly enhanced. Here all possible T = 1 single-particle-hole states of all allowed angular momenta are considered in a basis including single-particle states up to the 2s-1d shell. A simple square-well shell model is used to account for the quasielastic cross section in the giant-resonance region. All of the gross features of the experimental excitation spectrum for excitation energies between 14 and 30 MeV can be accounted for on the basis of this simple model. (auth)

35830 GAMMA-RAY YIELD FROM NEUTRON INTERACTIONS WITH ^{10}B. Nellis, Donald O.; Tucker, W. E.; Morgan, Ira L. (Texas Nuclear Corp., Austin). Phys. Rev., C; 1: 847-55(Mar 1970).

Cross sections for γ rays produced by neutron bombardment of ^{10}B are measured between 50 keV and 5 MeV and at 14.8 MeV. Special emphasis is placed on measurements of the 0.478-MeV γ ray from the $^{10}B(n,\alpha)^7Li$ reaction. Most of the unbound levels in ^{10}B do not emit any observable γ rays. The 0.478-MeV γ-ray production cross section shows a departure from 1/v above a neutron energy of 100 keV. (auth)

35831 NONCONSERVATION OF ISOSPIN IN THE $^{14}N(d,d')^{14}N$ REACTION. Duray, J. R.; Browne, C. P. (Univ. of Notre Dame, Ind.). Contract Nonr 1623(05). Phys. Rev., C; 1: 776-86(Mar 1970).

The $^{14}N(d,d')^{14}N$ reaction to the first excited state of ^{14}N(2.31 MeV, 0^+, 1) is investigated for isospin nonconservation. Angular distributions are taken for nine incident deuteron energies between 5 and 10 MeV. The symmetries observed in the angular distributions indicate a predominantly compound-nuclear reaction mechanism. The observed violation arises most probably from "Coulomb mixing" in the ^{16}O compound nucleus. The measured cross-section ratio of the first to the second (3.95 MeV, 1^+, 0) excited state of ^{14}N varies from 3 to 1% for deuteron energy increasing from 6 to 10 MeV. The region of excitation of ^{16}O between 26.0 and 31.0 MeV is investigated by measuring the excitation function for inelastic deuteron scattering to the second excited state of ^{14}N for deuteron energies between 5.9 and 12.2 MeV at a laboratory angle of 60°. Gross structure is observed at excitation energies of 27.2 and 29.6 MeV in ^{16}O. The presented data are compared with photoabsorption data for this range of excitation energy. (auth)

35832 EXTENSION OF THE OPTICAL MODEL AND ITS APPLICATION TO THE ELASTIC SCATTERING OF ^{16}O BY ^{16}O NUCLEI. Chatwin, R. A. (Florida State Univ., Tallahassee); Eck, J. S.; Robson, D.; Richter, A. Phys. Rev., C; 1: 795-803(Mar 1970).

The absorptive part of the optical potential is considered as a function of conserved quantum numbers such as the total angular momentum J. This investigation results in the introduction of a smooth cutoff in the strength of the absorptive potential as J gets larger than a certain critical value. This value is typical of nonelastic channels, and the cutoff reflects poor matching between the angular momenta in the elastic channel and those in the nonelastic channels. Brief consideration is also given to other conserved or approximately conserved quantum numbers such as isobaric spin and parity. The standard optical potential is modified to include an angular-momentum dependence with a suitable cutoff, and is applied to the elastic scattering of ^{16}O by ^{16}O nuclei. In the energy range 15–36 MeV (c.m.), such an extended optical model gives a good description of all the gross features of the ^{16}O–^{16}O data. A repulsive core in the ^{16}O–^{16}O potential has been considered, but no definite evidence for it is found in the present analysis. (auth)

35833 INTERPRETATION OF THE EXPERIMENTAL RESULTS OF THE REACTION $^{11}B(p,3\alpha)$ BETWEEN 0.68 AND 2 MeV. Giorni, A. (CEN, Grenoble, France). Nucl. Phys.; A144: 146-60 (1970). (In French).

The reaction amplitude T of the $^{11}B(p,3\alpha)$ reaction is written as $T = \tau + TG_0\tau$, where τ corresponds to the production of three uncorrelated α-particles by the reaction $^{11}B + p$, and T is the Faddeev operator in the three-body channel. The numerical calculation is made in the final state interaction approximation, i.e. $T \approx t$, where t is the two-body αα amplitude, given by the well-known phase-shifts δ_0 and δ_2. The matrix-element $\langle i|\tau|i\rangle$ is written as a Breit–Wigner formula, and after an angular decomposition of the total amplitude T, a good description of the Dalitz-plot for the $J^\pi = 2^-$, 1^- and 0^+ levels of ^{12}C is obtained. (auth)

35834 REACTION $^{12}C(^3He,\alpha)^{11}C$: 12.0 TO 18.6 MeV. Gray, T. J.; Fortune, H. T.; Trost, W.; Fletcher, N. R. (Florida State Univ., Tallahassee). Nucl. Phys.; A144: 129-45(1970).

Excitation functions for $^{12}C(^3He,\alpha)$ reactions leading to the ground state, first and third excited states of ^{11}C were measured at selected angles for $E_{^3He}$ = 12 to 18 MeV. Angular distributions were measured at bombarding energies of 16, 17 and 18 MeV for the ground state and four excited states to study the energy dependence of extracted spectroscopic factors. The ground state reaction is well represented at all energies by a zero-range, local DWBA calculation for neutron pickup with a renormalization factor of R ≈ 40, which is twice as large as the generally accepted value. At $E_{^3He}$ = 18 MeV angular distributions leading to the ground state and first ten excited states of ^{11}C were measured. In general the pickup calculations for the excited state reactions do not give a good representation of the measurements when the ground state optical parameters are used. (auth)

35835 DECAY SCHEMES OF ^{18}Ne, ^{22}Mg, AND ^{36}Ca FROM $(^3He,n\gamma)$ MEASUREMENTS. Shapiro, M. H. (California Inst. of Tech., Pasadena. Univ. of Rochester, N. Y.); Adams, A.; Moss, C.; Denny, W. M. Nucl. Phys.; A144: 17-41(1970).

The associated gamma-ray time-of-flight technique was used to investigate the principal decay modes of several low-lying levels in ^{18}Ne, ^{22}Mg and ^{36}Ca via the $(^3He,n\gamma)$ reaction. Neutron-gamma coincidence data obtained in this manner were used to limit the possible spin-parity assignments to these levels. In the ^{18}Ne case neutron-gamma angular correlation measurements yielded unique spin-parity assignments of 4^+ for the 3.38 MeV level and 2^+ for the 3.63 MeV level. Accurate values for the excitation energies of the ^{18}Ne bound states were obtained from supplementary Ge(Li) detector data using a pulsed beam neutron-gamma coincidence technique. The present results for ^{18}Ne were combined with published lifetime measurements for ^{18}Ne and ^{18}O to obtain experimental values of the isoscalar and isovector transition matrix elements for the $2_2^+ \rightarrow 2_1^+$ and $2_2^+ \rightarrow 0_1^+$ transitions in the A = 18, T = 1 triad. (auth)

35836 ROLE OF THE REAL NUCLEAR PHASE IN THE SCATTERING OF ALPHA PARTICLES. Bucurescu, D. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys.; 14: 1011-22(1969).

The elastic scattering of alpha particles by ^{12}C and ^{24}Mg at 42 MeV and by ^{24}Mg and ^{28}Si at 22.5 MeV is analyzed in terms of the diffraction model proposed by Ericson and Inopin. The interpretation given by Abul-Magd and Simbel to the parameter λ (the imaginary part of the complex cut-off angular momentum) is used to discuss the values obtained in this analysis. A method is given for the calculation of $(\alpha,\alpha'\gamma)$ angular correlations, using the parameters found in the elastic scattering analysis. (auth)

Nuclear Properties and Reactions, 20 ≤ A ≤ 89

Refer also to abstracts 35586, 35682, 35807, 35808, 35822, 35823, 35825, 35835, 35836, 35893, and 35926.

35837 INELASTIC ELECTRON SCATTERING FROM THE GIANT RESONANCE REGION OF ^{24}Mg, ^{26}Mg, AND ^{40}Ca WITH PRIMARY ENERGIES BELOW 60 MeV. Goldmann, Albrecht (Technische Hochschule, Darmstadt, Ger.). Z. Phys.; 234: 144-60(1970). (In German).

Inelastic electron scattering at low primary energies and scattering angles smaller than 180° represents a successful method for the investigation of giant resonances, even though the elastic radiation tail is not known exactly. Energy resolution and statistical accuracy are superior to other methods. It is shown, that the giant resonances in ^{24}Mg, ^{26}Mg and ^{40}Ca are excited mainly

via E1-absorption. Integrated cross sections agree with results of photon-experiments. A splitting of the ^{25}Mg-giant resonance into two broad bumps is interpreted as isospin-splitting. (auth)

35838 THRESHOLD REACTION EXCITATION FUNCTIONS INTERCALIBRATED IN A PURE FISSION SPECTURM. Bresesti, A. M. (EURATOM–CCR, Ispra, Italy); Bresesti, M.; Rota, A.; Rydin, R. A.; Lesca, L. Nucl. Sci. Eng.; 40: 331-48(May 1970).

An intercalibrated set of energy-dependent cross-section data for neutron reactions on ^{27}Al, ^{59}Co, ^{54,56}Fe, ^{115}In, ^{24}Mg, ^{58}Ni, and ^{238}U is presented. These reactions were intercalibrated in a pure fission spectrum from a specially designed converter facility. (J.W.R.)

35839 LIFETIME MEASUREMENTS IN sd-SHELL NUCLEI. I. MEAN LIVES OF ^{38}Ar LEVELS. Engelbertink, G. A. P.; Van Middelkoop, G. (Univ., Utrecht). Nucl. Phys.; A138: 588–600(1969).

The ^{41}K(p,$\alpha\gamma$) and ^{35}Cl(α,pγ) reactions were used to populate levels in ^{38}Ar. The mean lives of the lowest six excited states in ^{38}Ar were measured with the Doppler shift attenuation method. Gamma rays were detected at 90°, in coincidence with particles observed at angles θ = 100° and –100° or 110° and –110°. The ^{38}Ar* ions slowed down in thick carbon backings, the stopping power of which is known experimentally. Mean lives of τ_m = 540 ± 65, 7000 ± 4000, 75 ± 30, 46 ± 18, ≤1500 ± 330, and 25 ± 25 fs were found for the levels at E_x = 2.17, 3.38, 3.81, 3.94, 4.48, and 4.57, respectively. The relatively fast decay of the second excited state indicates that positive parity states in ^{38}Ar are only well described if $(ds)^{-4}(fp)^2$ shell-model configurations are taken into account. (auth)

35840 QUADRUPOLE MOMENTS OF FIRST EXCITED STATES IN ^{28}Si, ^{32}S, AND ^{40}Ar. Nakai, K.; Quebert, J. L.; Stephens, F. S.; Diamond, R. M. (Univ. of California, Berkeley). Phys. Rev. Lett.; 24: 903-6(20 Apr 1970).

Static quadrupole moments of the first excited states of ^{28}Si, ^{32}S, and ^{40}Ar are measured using the reorientation effect in projectile Coulomb excitation. The results obtained are Q(^{28}Si, 2^+) = +0.11 ± 0.05 b, Q(^{32}S, 2^+) = –0.20 ± 0.06 b, and Q(^{40}Ar, 2^+) = +0.01 ± 0.04 b. (auth)

35841 ENERGY DEPENDENCE OF ^{22}Na AND ^{24}Na PRODUCTION CROSS SECTIONS WITH 100- TO 400-MeV PROTONS. Korteling, Ralph G. (Simon Fraser Univ., Burnaby, British Columbia); Caretto, Albert A. Jr. Phys. Rev., C; 1: 1960-71 (Jun 1970).

Cross sections for the production of ^{22}Na and ^{24}Na are determined from targets between magnesium (Z = 12) and selenium (Z = 34) with 100-, 200-, and 300-MeV protons. The main feature of the results is the exponential decrease of the cross sections with increasing target atomic number or neutron number for values up to Z ≈ 30 and N ≈ 37. This feature is found to be consistent with the cross-section dependence predicted on the basis of a cascade-evaporation mechanism. Maxima are also observed in the cross-section distributions at atomic numbers greater than Z = 30. It appears that these maxima are caused by non-conventional cascade-evaporation events, since they have threshholds below 200 MeV. A major breakup process in which one of the fragments has greater stability is suggested as a possible mechanism. (auth)

35842 STUDY OF EXCITED STATES OF ^{47}V WITH THE ^{46}Ti(p,γ)^{47}V REACTION. Willmes, Henry (Aerospace Research Labs., Wright-Patterson Air Force Base, Ohio). Contract F33615-67-C-1758. Phys. Rev., C; 1: 1972-8(Jun 1970).

Angular distributions of γ-ray spectra from the ^{46}Ti(p,γ)^{47}V reaction are observed at the resonances E_p = 1095.4, 1127.0, and 1285.7 keV. Accurate level energies and a revised Q value of 5167.9 ± 1.5 keV are obtained. Branching ratios and multipolarity mixing ratios for numerous transitions are determined. The 2.175-MeV level is found to have spin ½. The resonance levels at E_p = 1095 and 1286 keV [E_x(^{47}V) = 6.241 and 6.425 MeV] are found to have spin ⅜. The resonance at E_p = 1127 keV (E_x = 6.271 MeV) is tentatively identified as the isobaric analog state of the 2.163-MeV level in ^{47}Ti, with J^π = ⅜$^-$. (auth)

35843 ENERGY SPECTRA OF NEUTRONS FROM THE REACTION ^{59}Co(p,n) AT E_p ~ 6.05 TO 6.3 MeV. Rozkos, M.; Sterba, F. (Charles Univ., Prague). Czech. J. Phys.; 20: 492-7(1970).

Neutron spectra from ^{59}Co(p,n) reaction were studied by nuclear emulsion method at 2 values of proton energy and 2 angles. Analysis of measured spectra leads to the conclusion that for excitation energy of residual nucleus $E^* \lesssim 1$ MeV a direct process is contributing, and above this value a "precompound" decay plays the most important role. (auth)

35844 EXPERIMENTAL EVIDENCE FOR LOW-LYING MANY-QUASIPARTICLE STATES IN NICKEL ISOTOPES. Faivre, J.-C.; Faraggi, H.; Gastebois, J.; Harvey, B. G.; Lamaire, M.-C.; Loiseaux, J.-M.; Mermaz, M. C.; Papinau, A. (Nuclear Physics Dept., Saclay, France). Phys. Rev. Lett.; 24: 1188-91(25 May 1970).

It was found that low-lying states are strongly excited in nickel isotopes by α-transfer reactions induced by 48-MeV oxygen ions on iron targets, i.e., via the four-particle, two-hole components of the nuclear wave functions. (auth)

35845 ANALYSIS OF THE REACTION ^{31}P(p,p$_0$) IN THE ENERGY RANGE 8.0 TO 10.0 MeV. Dallimore, P. J.; Hellstroem, J. (Australian National Univ., Canberra). Nucl. Phys.; A144: 103-15(1970).

Absolute differential cross sections were measured for the elastic scattering of protons from ^{31}P. Excitation functions were measured for incident proton energies from 8.0 to 10.0 MeV in 10 keV steps at 14 angles and in 50 keV steps at 13 angles. The energy averaged angular distributions were analyzed using the optical-model and Hauser–Feshbach theories and the excitation functions were analyzed using the statistical theory of fluctuations. The fractions of direct reaction calculated by the two methods were compared and are in good agreement for values of $Y_D \gtrsim 0.8$. (auth)

35846 PROTON SCATTERING ON DOUBLY EVEN SELENIUM ISOTOPES. Hentschel, E.; Heinrich, G. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Nucl. Phys.; A144: 92-102(1970).

The scattering of 6.4 MeV protons on the doubly even nuclei ^{76,78,80,82}Se was investigated, measuring the differential cross section and polarization for the elastic scattering and the differential cross section for the inelastic scattering. The excitation of the first 2^+ level was analyzed by means of DWBA calculations. Deduced β_2 values agree with those obtained by B(E2) measurements. The simultaneous description of the elastic and inelastic scattering was found to be valid and resulted in a better determination of the surface absorption diffuseness a_D. Supported by the data of the elastic scattering polarization a relation $a_D \approx \beta_2$ seems to be valid. (auth)

35847 ENERGY LEVELS OF SOME Zn, Ga, As, Se, AND Br ISOTOPES FROM (p,n) REACTIONS. Finckh, E.; Jahnke, U.; Schreiber, B.; Weidinger, A. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). Nucl. Phys.; A144: 67-80(1970).

The energy level schemes of ^{65}Zn, ^{67}Ga, ^{70}Ga, ^{74}As, ^{76}As, ^{75}Se, ^{76}Br, ^{80}Br and ^{82}Br were determined by (p,n) compound reactions using time-of-flight techniques. The deduced level schemes contain many more levels than known from the literature and will be complete except for states with high spin values, which are only weakly populated by compound nucleus reactions. The comparison with the results of γ-investigations showed that some γ-transitions in ^{67}Ga and ^{70}Ga are assigned erroneously. The reaction Q-values are in agreement with published values. (auth)

35848 A STUDY OF THE EXCITED STATES OF ^{53}Cr VIA THE ^{52}Cr(d,p)^{53}Cr REACTION. Carola, T. P. G.; Olsen, W. C.; Sheppard, D. M.; Sowerby, B. D.; Twin, P. J. (Univ. of Alberta, Edmonton). Nucl. Phys.; A144: 53-66(1970).

The decay modes of many of the excited states of ^{53}Cr below 4.25 MeV excitation energy were determined by means of the ^{52}Cr(d,p)^{53}Cr reaction. Previous tentative spin assignments of ½$^-$, ⅜$^-$ and ½$^+$ to the 1.006, 2.324, and 3.715 MeV levels respectively were confirmed. New spin assignments are the following: ½ or ⅜ to the 2.227 MeV level, ⅜$^-$ to the 3.190 MeV level, ½ to the 3.271 MeV level and ½ or ⅜ to the 3.971 MeV level. Multipole mixing ratios are given for many of the observed transitions. Comparison is made with available theoretical calculations based on both the unified and shell models. (auth)

35849 EXCITED STATES IN ^{27}Al FROM THE REACTION ^{26}Mg(p,p)^{26}Mg. Murata, Tohru (Nippon Atomic Industry Group Co., Kawasaki, Japan); Chiba, Ren; Katori, Kenji; Kawai, Nawoyuki; Takayanagi, Seiich. J. Phys. Soc. Jap.; 28: 1101-7(May 1970).

The differential cross-sections for the elastic scattering of protons from ^{26}Mg were measured over the energy range of incident protons from 1.2 to 3.0 MeV. Measurements were made at three cm angles of 90.0, 125.3 and 165.6° with energy steps of 1.5 keV. Isotopically pure ^{26}MgO on a carbon backing foil was used as a target. Overall energy resolution was estimated to be 2 to 3 keV. Thirty-four resonances were observed and an attempt was made to fit these resonances by using the multi-level resonance formula. The experimental results are discussed in terms of the rotational model based on the potential model including isobaric spin term. (auth)

35850 OPTICAL-MODEL PREDICTIONS FOR THE WOLFENSTEIN PARAMETERS R(ϑ) AND A(ϑ) FOR LOW-ENERGY PROTONS ON ^{24}Mg, ^{27}Al, AND ^{63}Cu. Boca, I. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys.; 14: 1035-43(1969).

By means of the optical model, the parameters of Wolfenstein R(ϑ) and A(ϑ) for ^{24}Mg at E_p = 4.5, 5.8; 6.7, 7.4, 7.8, 9.4 and 9.8 MeV, ^{27}Al at E_p = 6.7 and 7.5 MeV, and ^{63}Cu at E_p = 6.7 and 7.5 MeV, incident protons were calculated using Rosen optical model parameters. For all the cases the spin-rotation parameter β_{cm} was calculated too. The computations were carried out neglecting the influence of the target spin. Some considerations on the results are presented. These theoretical predictions could be helpful in the planning of such experiments at low energy. (auth)

35851 RELATIVE NATURE OF THE THIRD MAXIMUM IN ANGULAR DISTRIBUTION OF ELASTICALLY SCATTERED DEUTERONS. Vereshchagin, A. N.; Terenetskii, K. O.; Chernov, I. P.; Tokarevskii, V. V. Izv. Akad. Nauk SSSR, Ser. Fiz.; 34: 460-3(Feb 1970). (In Russian).

Published data on differential cross sections of elastic deuteron scattering at 13.6 MeV reported anomalies in angular distributions. Among them was mentioned the behavior of the so-called third maximum in the nuclear range of A ≈ 50. An attempt was made to explain these anomalies using new experimental data and a more realistic optical potential. The elastic scattering of 13.6 MeV deuterons on ^{40}Ca, $^{46-50}$Ti, and ^{55}Mn was measured. Data obtained were analyzed considering the spin-orbital interactions in the optical deuteron potential. (R.V.J.)

35852 ANALYSIS OF ELASTIC AND INELASTIC SCATTERING OF 6 MeV PROTONS ON MEAN ATOMIC WEIGHT NUCLEI. Antropov, A. E.; Vasil'ev, S. I.; Zarubin, P. P.; Orlov, B. N.; Plavko, A. V.; Sorokin, A. I. Izv. Akad. Nauk SSSR, Ser. Fiz.; 34: 400-8(Feb 1970). (In Russian).

Experimental data on proton scattering at 3 to 20 MeV energy were analyzed in order to determine the applicability of the distorted wave method in studies of proton scattering on $^{58-64}$Ni isotopes. Data on proton scattering with 6 MeV energy on ^{59}Co, $^{58-64}$Ni, ^{63,65}Cu were also analyzed using the distorted wave method and the Hauser–Feshbach theory without considering the interference between direct and indirect scattering. (R.V.J.)

35853 STRIPPING OF DEUTERONS WITH 2.45-GeV/c MOMENTUM IN NUCLEAR EMULSION. Lojova, M.; Tucek, J. (P. J. Safarik Univ., Kosice, Czech.). Czech. J. Phys.; 20: 395-400(1970).

This paper is concerned with the evaluation of the cross section σ(d,p) of the stripping due to collision of a fast-deuteron beam with atom nuclei forming a photographic nuclear emulsion without evaporation of nuclei. The cross section was estimated using the deuteron mean free path with respect to mentioned reactions. The deuteron track on which the stripping reaction took place was identified according to the change of the characteristic of multiple scattering. Corrections were taken for the primary-beam impurities and for the length of each track where reaction was not identifiable. (auth)

35854 ANGULAR DISTRIBUTION OF PROTONS FROM THE REACTION ^{59}Co(n,p)^{59}Fe FOR E_n ~ 6.3 MeV. Rozkos, M.; Sterba, F.; Wilhelm, I. (Charles Univ., Prague). Czech. J. Phys.; 20: 487-91(1970).

The energy and angular distributions of protons in the reaction ^{59}Co(n,p)^{59}Fe were measured for E_n = 6.3 MeV. The results show the presence of mechanism other than compound nucleus. (auth)

35855 ^{24}Na GAMMA-RAY EXCITATION OF NUCLEAR ISOMERS. Abrams, I. A.; Lakoshi, L. (Inst. of Physics, Riga). Latv. PSR Zinat. Akad. Vestis, Fiz. Teh. Zinat. Ser.; No. 6, 3-10(1969). (In Russian).

A possibility of ^{24}Na gamma-ray excitation of nuclear isomers ^{77m}Se, ^{79m}Br, ^{103m}Rh, $^{107m+109m}$Ag, ^{111m}Cd, ^{115m}In, ^{167m}Er, ^{179m}Hf, ^{183m}W, ^{197m}Au was investigated. The activation cross sections or the upper limit for the cross sections was determined. The gamma-activation method for measuring large activities is suggested. (auth)

35856 RADIATIVE CAPTURE CROSS SECTIONS FOR FAST NEUTRONS IN ^{55}Mn, ^{69}Ga, ^{71}Ga, AND ^{98}Mo. Dovbenko, A. G.; Kolesov, V. E.; Koroleva, V. P.; Tolstikov, V. A. At. Energ. (USSR); 26: 67-72(Jan 1970). (In Russian).

The radiative capture cross sections of ^{55}Mn, ^{69}Ga, ^{71}Ga and ^{98}Mo nuclei for 0.2- to 3.0-MeV neutrons were determined by the activation method. The T(p,n)^{3}He reaction in a Van de Graaff accelerator served as the fast-neutron source for the measurements, using a ^{238}U fission chamber for monitoring the fast neutron flux; the induced activity was determined by means of β counters. The results are plotted against the fast neutron energy. The ^{55}Mn data agreed with earlier results; some of the higher values are attributed to scattering effects. The ^{71}Ga data also agree with renormalized values for E_n > 1 MeV; for E_n < 1 MeV, the data were about 15% higher. There were some differences for ^{98}Mn data as compared with literature values, although the shapes of the curves of the dependence of δ(n,γ) on E_n are similar. The results confirm the possibility of using the statistical theory of nuclear reactions for the quantitative estimation of radiative capture cross sections. (TTT)

35857 COINCIDENCE SPECTRA OF GAMMA RAYS FROM (n,γ) REACTIONS ON ^{74,76}Se ISOTOPES. Bogdanov, A. P.; Soroka, A. V.; Tadeush, V. N.; Firsov, E. I. (Inst. of Physics, Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Mat. Navuk; No. 6, 119-20 (1969). (In Russian).

A scintillation coincidence spectrometer was used to study the γ cascades following the capture of thermal neutrons by ^{74}Se and ^{76}Se. (tr-auth)

35858 EXCITED STATES IN ^{40}Ar FROM INELASTIC ALPHA-PARTICLE SCATTERING. Wakatsuki, Tetsuo; Takahashi, Noriaki; Suzuki, Katsumichi; Itahashi, Takahisa; Hirao, Yasuo (Osaka Univ.). J. Phys. Soc. Jap.; 28: 1107-15(May 1970).

The (α,α′) reaction was investigated on ^{40}Ar at 21.5 and 22.2 MeV of incident energies. Spin and parity assignments were made on the basis of Blair's phase rule and the distorted wave Born approximation. The energy levels and their spins and parities found were compared with results of previous experiments and theoretical considerations. Spin and parity of 2^+ for the 2.529 MeV level are considered decisive, while spin and parity of (1^-) are proposed for the 3.21 MeV level. (auth)

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Refer also to abstracts 33704, 33931, 33932, 34842, 35585, 35774, 35799, 35807–35809, 35822, 35823, 35838, 35855, and 35856.

35859 (BNL-tr-323) NEUTRON CROSS SECTIONS OF CADMIUM ISOTOPES. Vertebnyi, V. P.; (and others). Translated by Stephen J. Amoretty (Brookhaven National Lab., Upton, N. Y.), from At. Energ. (USSR); 27: 349-(1969). 5p. Dep. CFSTI.

For the study of absorber burnout the total neutron and scattering cross sections of ^{111}Cd, ^{112}Cd, ^{114}Cd, and ^{116}Cd were measured. These cross sections are given, and the experimental techniques are described. (J.F.P.)

35860 (ITEF-707) HIGH ENERGY PROTONS DURING ABSORPTION OF MUONS BY EMULSION NUCLEI. Vaisenberg, A. O.; Kolganova, E. D.; Rabin, N. V. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi i Eksperimental'noi Fiziki). 1969. 27p. (In Russian). Dep. CFSTI (U. S. Sales Only).

The 25-MeV proton spectrum of emitted heavy nuclei of the Ag_1Br emulsion is studied at the capture of stopped negative muons. It is shown that the number of the fast secondary protons is $(3.16 \pm 0.34) \cdot 10^{-4}$ and $(4.7 \pm 1.1 \cdot) \cdot 10^{-5}$ per one capture for proton energies more than 25 and 40 MeV, respectively. The background of the pion stars is studied in detail. The value of the background of one-prong stars with protons of $E_p \geq 25$ MeV and $E_p \geq 40$ MeV does not exceed 8% and 30%, respectively. (auth)

35861 (LA-tr-69-33) EVEN-ODD DIFFERENCES AND STRUCTURE OF FISSION BARRIERS. Ignatiuk, A. V.; Smirenkin, G. N. ([Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Obninsk]. Fiziko-Energeticheskii Institut). Translated by Helen J. Dahlby (Los Alamos Scientific Lab., N. Mex.), from report FEI-157. 5p. Dep. CFSTI.

An attempt is made to show the possibility of explaining all data on the even-odd differences of fission barriers within the framework of the concept of double-humped fission barrier. (L.W.A.)

35862 (PUC-937-369) NEW NEUTRON RICH ISOTOPES PRODUCED IN 3 GeV PROTON REACTIONS. Raisbeck, G. M.; Boerstling, P.; Riesenfeldt, P. W.; Klapisch, R.; Thomas, T. D. (Princeton-Pennsylvania Accelerator, Princeton, N. J.); Garvey, G. T. (Princeton Univ., N. J.). Sep 1969. 8p. Dep. CFSTI.

The study of neutron rich, light isotopes ($7 \leq A \leq 25$) produced at relatively low kinetic energy from the reaction of 3 GeV protons on Au-197 is discussed. The immediate object of these experiments is to establish the limits of particle stability for neutron rich

isotopes with $Z \leq 8$. The limit of heavy particle stability represents a sensitive test for the various procedures used for predicting nuclear masses far removed from the valley of beta stability. (L.W.A.)

35863 NEUTRON SPECTRA AND THE EXCITATION SPECTRUM OF THE FISSION PRODUCTS. Pik-Pichak, G. A. At. Energ. (USSR); 27: 568-9(Dec 1969). (In Russian).

The distribution of the residual temperatures of fission products (the sum of fission product temperature distributions after emission of one, two or more neutrons) can be obtained directly from the experimental spectra of fission neutrons. In this case it is not necessary to use any concrete nuclear model so that the reliability of the results is increased. An equation is given for the probability of neutron emission at an angle $d\theta$ with kinetic energy n by a fission fragment I as a function of the residual temperature T_1. It is assumed that the process of neutron emission from the fission fragment can be described thermodynamically. A distribution of residual temperatures involving Chebyshev polynomials is assumed for the fission fragments. Expressions are then obtained for the energy distribution of the neutrons and for the total number of neutrons emitted in the fission process. The experimental distribution of residual temperatures is somewhat wider for the light fragment, and narrower for the heavier fragment as compared with the theoretical distributions which are assumed to be the same for both fission fragments. The average excitation energy carried off by gamma quanta should be close to half the sum of the binding energies in the light and heavy fission fragments (~5.2 MeV), but the experimental value turn out to be 7.2 MeV for ^{252}Cf. This difference cannot be explained by taking pairing into account, but is connected with the presence of mechanical energy such as rotational energy. (TTT)

35864 γ-γ-ANGULAR CORRELATION MEASUREMENTS IN THE DECAY OF ^{185}Os. Strum, R.; Theile, F. W.; Thielmann, R.; Gruenberg, E. (Univ., Marburg, Ger.). Z. Phys.; 234: 171-80(1970). (In German).

Angular correlations of the gamma cascades (592–125), (162–718), (233–646), and (162–592) keV were measured. The spin of the 879-keV level was found as ½. The mixing ratios of the 125-, 162- and 718-keV gamma transitions were determined. (auth)

35865 DECAY OF ^{97}Zr TO NUCLEAR STATES OF ^{97}Nb. Megli, D. G.; Agin, G. P.; Potnis, V. R.; Mandeville, C. E. (Kansas State Univ., Manhattan). Z. Phys.; 234: 95-106(1970).

The gamma rays emitted in disintegration of ^{97}Zr were investigated by Ge(Li) detectors, operated singly and in coincidence. In all, quanta emitted in thirty-five nuclear transitions were observed. The gamma ray energies and relative intensities were measured. Beta spectra were studied with Ge(Li) detector and anthracene counter in coincidence. Nine beta spectra were identified as to end point and intensity, either by direct measurement or by inference from the gamma ray data. The results of all measurements were combined to provide a decay scheme for ^{97}Zr. Nuclear excited states in ^{97}Nb are indicated at energies of 743, 1,148, 1,251, 1,276, 1,434, 1,548, 1,652, 1,750, 1,765, 1,852, 1,958, 2,056, 2,106, and 2,247 keV. Possible spin-parity assignments were suggested for some of these states. (auth)

35866 SPREADING OF ANALOG RESONANCES IN INELASTIC PROTON CHANNELS. Lieb, Klaus Peter (Univ. Nacional de Colombia, Bogota); Burch, David. Z. Phys.; 234: 161-70(1970).

The reaction ^{96}Zr(p,p′) leading to the 1.76-MeV excited state was studied at the 6.22-MeV $\frac{1}{2}^+$ analog resonance. Excitation functions taken at 150 and 170° were analyzed in terms of Weidenmueller's theory, in order to deduce the spectroscopic factor, external spreading width and level shift in the inelastic channel. An upper limit of 3.2 keV for the internal spreading width of this resonance was set. (auth)

35867 MULTILEVEL PARAMETERS FOR THE ^{239}Pu FISSION CROSS SECTION FROM 40 TO 100 eV. Lambropoulos, P. (Argonne National Lab., Ill.). Nucl. Sci. Eng.; 40: 342-6(May 1970).

The Adler-Adler method was used to calculate multilevel parameters for the ^{239}Pu fission cross section from 40 to 100 eV. The analysis seems to reveal a larger number of levels than previously reported. However, the existence and position of some of these cannot be considered conclusive until further analysis of the total or capture cross section. (J.W.R.)

35868 MEASUREMENTS OF THE NEUTRON FISSION AND ABSORPTION CROSS SECTIONS OF ^{239}Pu OVER THE ENERGY REGION 0.02 eV TO 30 keV. Gwin, R. (Oak Ridge National Lab., Tenn.); Weston, L. W.; de Saussure, G.; Ingle, R. W.; Todd, J. H.; Gillespie, F. E.; Hockenbury, R. W.; Block, R. C. Nucl. Sci. Eng.; 40: 306-16(May 1970).

The neutron absorption and fission cross sections for ^{239}Pu were measured simultaneously over the neutron energy range from 0.02 eV to 30 keV. An electron linear accelerator was used to produce a source of pulsed neutrons which are collimated to impinge on the ^{239}Pu sample located at the center of a large liquid scintillator. The prompt gamma rays resulting from fission or from neutron capture were detected using the large liquid scintillator. A fission event was measured in one case by using an ionization chamber containing ^{239}Pu. In another case using metal foils of ^{239}Pu, a technique depending upon the difference in the shape of the pulse height distributions for the prompt gamma rays from fission and capture was used to distinguish fission events. The data were normalized at 0.025 and 0.3 eV using data previously reported. A brief description of the experiments is given and a comparison of the present data with previously published data is given. (auth)

35869 SPINS OF GENERALIZED NEUTRON PARTICLE-HOLE STATES IN ^{140}Ce WITH EXCITATION ENERGIES ABOVE $E_x = 4$ MeV. Heusler, A. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Nucl. Phys.; A141: 667-72(1970).

Spins are assigned to states in ^{140}Ce observed in the proton decay of resonances which are the isobaric analogs of the first ($J^\pi = \frac{3}{2}^-$), second ($J^\pi = \frac{1}{2}^-$), and fifth ($J^\pi = \frac{1}{2}^-$) excited states in ^{141}Ce. Spins 2^-, 1^-, 2^-, 2^-, and 1^- are assigned to the states at $E_x = 4.158$, 4.182, 4.580, 4.748, and 4.77 MeV in ^{140}Ce, respectively. The states at $E_x = 5.026$, 5.196, 5.424, and 5.466 MeV are shown to have spins 2^- or 3^-. The assignments are based on the assumption that only the generalized neutron particle-hole configurations $|d_{\frac{5}{2}}^{-1} \otimes {}^{141}\mathrm{Ce}(J\beta)\rangle$ and $|s_{\frac{1}{2}}^{-1} \otimes {}^{141}\mathrm{Ce}(J\beta)\rangle$ contribute to the proton widths measured on the resonance $J\beta$. (auth)

35870 NUCLEAR STRUCTURE STUDIES OF ^{93}Nb USING THE ^{93}Nb(n,n′γ) AND ^{93}Nb(p,p′γ) REACTIONS. Rogers, V. C ; Beghian, L. E.; Clikeman, F. M.; Hofman, F.; Wilensky, S. (Massachusetts Inst. of Tech., Cambridge). Nucl. Phys.; A142: 100-12(1970).

The energy level structure of ^{93}Nb is investigated with the ^{93}Nb(n,n′γ) reaction and with Coulomb excitation. In particular, the data indicate doublets at 808 and 809 keV as well as 952 and 980 keV. A consistent set of spins has been determined for all levels with energies less than 1.5 MeV. The spin assignments mainly based upon a comparison of the measured and calculated neutron inelastic scattering excitation functions and γ-ray transition rates are in qualitative agreement with shell-model calculations. (auth)

35871 FISSION FRAGMENT MASS DISTRIBUTIONS AND KINETIC ENERGIES FOR SPONTANEOUSLY FISSIONING ISOMERS. Ferguson, R. L.; Plasil, F.; Alam, G. D.; Schmitt, H. W. (Oak Ridge National Lab., Tenn.). Phys. Lett.; 31B: 526-8(13 Apr 1970).

Fragment energy correlation experiments are used to study isomers formed in the reactions ^{235}U(d,p)^{236m}U and ^{240}Pu(p,2n)^{239m}Am. The observed mass distributions and fragment kinetic energies are consistent with those which occur in prompt low-excitation fission of the actines. (auth)

35872 SYSTEMATICS OF PLUTONIUM FISSION ISOMERS. Burnett, S. C.; Britt, H. C.; Erkkila, B. H.; Stein, W. E. (Los Alamos Scientific Lab., N. Mex.). Phys. Lett.; 31B: 523-5(13 Apr 1970).

Half-lives, thresholds and isomer ratios of $^{236,237-240m}$Pu fission isomers are given. Systematics indicate that ^{236,238m}Pu are anomalous. The measured thresholds of ^{238,240m}Pu are larger than those deduced from (n,f) data. (auth)

35873 POLARISATION EFFECTS IN $\delta\langle r^2\rangle$ MEASUREMENTS. Speth, J. (Technische Hochschule, Munich). Phys. Let.; 31B: 513-15(13 Apr 1970).

The changes of the mean square charge radius and the quadrupole moment of the ground state of ^{152}Sm and ^{156}Dy due to a muon and to a change of the s-electron density, respectively, are calculated. It turns out that in Mössbauer measurements the estimated ratio of the energy shift due to this polarization to the usual isometric shift is 2.6 times as large as in muon experiments. (auth)

35874 LOW ENERGY PROPERTIES OF THE ODD MASS ANTIMONY ISOTOPES. Sen, S.; Sinha, B. K. (Saha Inst. of Nuclear Physics, Calcutta). Phys. Lett.; 31B: 509-12(13 Apr 1970).

The different low energy properties of the odd mass Sb isotopes from $A = 115$ to $A = 125$ are calculated in a semi-microscopic model. Calculated results are compared with recent experimental findings. (auth)

35875 EFFECT OF CORE POLARIZATION IN THE REACTION ^{209}Bi(p,p′)^{209}Bi(1.61 MeV) AT 39.5 MeV. Benenson, W.

(Michigan State Univ., East Lansing); Austin, S. M.; Locard, P. J.; Petrovich, F.; Borysowicz, J. R.; McManus, H. Phys. Rev. Lett.; 24: 907-10(20 Apr 1970).

The cross section for the $1h_{9/2} - 1i_{13/2}$ single-proton transition in the reaction $^{209}Bi(p,p')^{209}Bi^*$ at 39.5 MeV is measured. It is shown that most of the observed cross section is due to admixtures of the state formed by coupling the valence proton of ^{209}Bi to the highly collective 3^- state of ^{208}Pb at 2.614 MeV. An estimate of core polarization, based on the work of Kuo and Brown, grossly underestimates the L = 3 component of the cross section. (auth)

35876 PROJECTION MODEL FOR GROUND BANDS OF EVEN–EVEN NUCLEI. Haapakoski, P.; Honkaranta, T.; Lipas, P. O. (Univ. of Helsinki). Phys. Lett.; 31B: 493-5(13 Apr 1970).

The vibrational ground state for an axially symmetric intrinsic system is calculated in terms of the usual spherically symmetric phonons. The laboratory states are then generated by the Peierls–Yoccoz angular-momentum projection method. The expectation value of a harmonic laboratory Hamiltonian in these states gives quite good agreement with the observed ground bands, e.g., in ^{152}Gd and ^{152}Sm. (auth)

35877 HIGH-ENERGY PROTON SPALLATION OF ARGON. Brodzinski, R. L.; Wogman, N. A. (Battelle Memorial Inst., Richland, Wash.). Contract AT(45-1)-1830. Phys. Rev., C; 1: 1955-9(Jun 1970).

The cross sections for production of ^{39}Cl, ^{38}Cl, ^{37}S, ^{34m}Cl, ^{29}Al, ^{28}Al, ^{28}Mg, ^{27}Mg, ^{24}Na, ^{22}Na, ^{18}F, and ^{7}Be from the proton spallation of argon at 310, 425, and 578 MeV are reported. Experimental production rates and experimental production ratios of the various radioisotopes to ^{38}Cl are compared to theoretical spallation yield calculations. Applications of the cross sections to health physics problems associated with high-energy accelerators and to studies of atmospheric processes are discussed. (auth)

35878 SINGLE PARTICLE POTENTIALS AND NUCLEON DENSITY DISTRIBUTIONS FOR ^{208}Pb. Batty, C. J. (Rutherford High Energy Lab., Chilton, Eng.). Phys. Lett.; 31B: 496-8 (13 Apr 1970).

Single particle potentials obtained from fitting nuclear reaction data and the positions of single particle and single hole states relative to ^{208}Pb are reviewed. The discrepancy between the neutron potentials fitting the reaction data and those fitting the level positions is discussed. (auth)

35879 NOTE ON EFFECTIVE CROSS SECTIONS IN THE RESOLVED RESONANCE REGION OF ^{238}U. Tone, Tatsuzo; Nakagawa, Masayuki. J. Nucl. Sci. Technol. (Tokyo); 7: 182-9 (Apr 1970).

Effects brought by Doppler broadening of ^{238}U on the effective cross sections—particularly on the elastic removal cross section σ_{er}—were examined in the energy interval from 0.465 to 3.952 keV. The calculations were performed on the code RIFF RAFF-H (a homogeneous version of RIFF RAFF), which solves numerically the slowing down equation in ultrafine groups with lethargy width 10^{-4} for a composition containing resonant nuclides. It was revealed that for ^{238}U the same shielding factor cannot be applied to both σ_{er} and scattering cross section as done in the Russian group-constants set, and that the σ_{er} of light and medium nuclides has appreciable temperature dependence on account of the Doppler effect of ^{238}U, especially in the low energy region. (auth)

35880 EXCITATION OF ISOMERIC ACTIVITIES FOR SOME N = 81 ISOTONES USING 14.5 MeV NEUTRONS. Rurarz, Edward; Haratym, Zbigniew; Sulik, Andrzej (Inst. of Nuclear Research, Swierk, Poland). Nukleonika; 14: 933-9(Oct 1969).

The cross section for the production of the isomeric states in ^{137}Ba, ^{139}Ce, ^{141}Nd and ^{143}Sm through the (n,2n) reaction using (14.5 + 0.2) MeV neutrons measured by the activation method. The experimental results were compared with those obtained by other authors. (auth)

35881 THE LEVEL STRUCTURE OF ^{181}Ta FROM (n,n'γ) EXPERIMENTS. Rogers, V. C.; Beghian, L. E.; Clikeman, F. M.; Mahoney, F. S. (Massachusetts Inst. of Tech., Cambridge). Nucl. Phys.; A144: 81-91(1970).

The level structure of ^{181}Ta was examined by studying the spectra and excitation functions of gamma rays resulting from the (n,n'γ) process for primary neutrons between the energies of 0.24 and 1.8 MeV. Gamma rays which are consistent with the following level structure were observed: $6(7/2^-)$, $136(9/2^+)$, $159(11/2^-)$, $301(11/2^+)$, $339(13/2^-)$, $482(5/2^+)$, $498(13/2^+)$, $548(15/2^-)$, $615(1/2^+)$, $619(3/2^+)$, $718(15/2^+)$. Previously unreported levels at 339 and 548 keV fit into the $(7/2^-)$ 514 rotational band. (auth)

35882 NEW ISOMER OF $^{110}Rh(T_{1/2} = 28s)$. Pinston, J. A.; Schussler, F. (CEN, Grenoble, France). Nucl. Phys.; A144: 42-52(1970). (In French).

Study of beta and gamma activities produced by (n,p) reaction of enriched ^{110}Pd has shown a new ^{110}Rh isomer, of 28 s half-life. Six new levels, at 1398, 1574, 1900, 2446, 2791 and 2804 keV are attributed to ^{110}Pd. The decay energy of this new isomer is estimated at 5400 keV. Also measured with good accuracy was the half-life of the other isomer of ^{110}Rh. (auth)

35883 PRECISE MEASUREMENTS OF THE AVERAGE KINETIC ENERGY OF FRAGMENTS IN THE FISSION OF ^{235}U BY FAST NEUTRONS. Ajitanand, N. N. (Bhabha Atomic Research Centre, Bombay); Boldeman, J. W. Nucl. Phys.; A144: 1-6(1970).

The average total kinetic energy of fragments in the fission of ^{235}U by neutrons of energies ranging from 200 to 900 keV was measured using two solid-state detectors to detect the fission fragments in coincidence. The average total kinetic energy of fragments is independent of the incident neutron energy and, within experimental error, does not show the reported discontinuity around 300 keV neutron energy. (auth)

35884 CALCULATION OF THE SPIN- AND ENERGY-DEPENDENT FISSION WIDTHS FOR ^{233}U, ^{235}U, ^{239}Pu, AND ^{241}Pu FROM CHANNEL THEORY. Kikuchi, Yasuyuki; An, Shigehiro. J. Nucl. Sci. Technol. (Tokyo); 7: 157-75(Apr 1970).

The spin- and energy-dependence of the fission widths are estimated for ^{233}U, ^{235}U, ^{239}Pu and ^{241}Pu from the channel theory of nuclear fission. The spin-dependent fission widths are deduced, by assuming the appropriate transition state spectrum, and the fission and capture cross sections are calculated with these fission widths. The results thus derived agree well with the experimental data which differ distinctively from nuclide to nuclide, and this is despite closely similar transition state spectra assumed for the different nuclides. This fact supports the validity of the spin-dependent fission widths derived from channel theory. The ratio $\Gamma_f^{(I-1/2)}/\Gamma_f^{(I+1/2)}$ for the states due to s-wave neutrons are as follows: 2.5 for ^{233}U, 1.8 for ^{235}U, between 74 and 210 for ^{239}Pu and 2.4 for ^{241}Pu. The fission widths of ^{239}Pu are thus seen to have exceptionally strong spin-dependence compared with the other nuclides. (auth)

35885 LEVELS OF ^{144}Nd EXCITED BY THERMAL NEUTRON CAPTURE. Berzin, Ya. Ya.; Kruminya, A. E.; Prokof'ev, P. T. (Inst. of Physics, Riga). Izv. Akad. Nauk SSSR, Ser. Fiz.; 34: 449-53(Feb 1970). (In Russian).

The spectrum of conversion electrons emitted during thermal neutron capture by ^{143}Nd nuclei was studied using a β spectrograph with 0.1 to 0.4% resolving power. Forty new transitions were observed in the electron energy region of 150 to 1750 keV. The additional data were used for expanding the level scheme and determining the energies with a higher degree of accuracy. (R.V.J.)

35886 PROBABILITIES OF FISSION WITH LONG-RANGE PARTICLE EMISSION. Solov'eva, Z. I. Izv. Akad. Nauk SSSR, Ser. Fiz.; 34: 438-43(Feb 1970). (In Russian).

Data obtained on the probabilities of ^{238}U fission by neutrons with 2.5, 7.0, and 190 MeV with long range particle emission were correlated to the graphs given in published literature for the component nuclei ^{232}Th, ^{236}U, ^{237}Np, and ^{242}Pu. (tr-auth)

35887 POSITRONS IN ^{154}Tb AND ^{154m}Tb DECAY. Ageev, V. A.; Mitrokhovich, N. F.; Feoktistov, A. I. (Kiev State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 34: 435-7(Feb 1970). (In Russian).

The positron decays of ^{154}Tb ($T_{1/2}$ = 21 hr) and ^{154m}Tb ($T_{1/2}$ = 5 hr) were studied using a 4π-β^+ detector and scintillation coincidence γ spectrometer. (R.V.J.)

35888 DECAY STUDIES OF ^{144}Gd AND ^{145}Gd ISOTOPES. SINGULARITIES OF THE QUASIPARTICLE LEVELS $2d_{5/2}$ AND $3s_{1/2}$. Arl't, R.; Baier, G.; Muziol, G.; Peker, L. K.; Pfrepper, G.; Shtrusnyi, Kh. (Joint Inst. for Nuclear Research, Dubna, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 34: 409-18(Feb 1970). (In Russian).

Gamma spectrum in the β^+ decay of ^{145}Gd was studied by means of a Ge(Li) spectrometer. Considering that the half-life of isotopes with N = 81 is one order smaller than that of isotopes with N = 80, it was anticipated that the half-life of the ^{144}Gd decay would be $T_{1/2} \geq 25$ min. However, the results of the experiment produced the half-life period of $T_{1/2} = 4.9 \pm 0.4$ min, for ^{144}Gd and 2.3 ± 1 for ^{145}Gd. (R.V.J.)

35889 STUDIES OF POSITRON DECAY OF ^{146}Gd, ^{146}Eu, AND ^{148}Eu. Ageev, V. A.; Mitrokhovich, N. F.; Feoktistov, A. I.

(Kiev State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 34: 397-9 (Feb 1970). (In Russian).

The positron spectra of ^{146}Gd, ^{146}Eu, and ^{148}Eu and their γ spectra in coincidence with annihilation emission were measured using a 4π-β^+ detector and scintillation type coincidence γ spectrometer. The β^+ decay of ^{146}Gd with end-point energy of 350 ± 30 keV and 0.07 ± 0.02% (lg ft = 7.2) intensity was determined. In β^+ decay of ^{147}Eu a new component of 540 ± 30 keV (0.06 ± 0.02%, lg ft = 8.9 was discovered in addition to the known component 940 ± 40 keV. (R.V.J.)

35890 THE 2^+ AND 3^- COLLECTIVE STATES IN THE Sn AND Zr ISOTOPES USING SCHEMATIC FORCES. Rizek, J.; Vogel, P. (Nuclear Research Inst., Rez, Czech.). Czech. J. Phys.; 20: 666-76(1970).

The energies and transition probabilities of the low-lying 2^+ and 3^- states in the Sn and Zr isotopes were calculated by the Random Phase Approximation method. The results for δ-force and surface delta interaction are compared. The properties of 3^- states are practically independent of the residual interaction used while for the 2^+ states the adequate agreement with experimental data was obtained using δ-force only. The influence of the interaction in the particle-particle channel proves to be important in the case of 2^+ excitations only. (auth)

35891 LEVELS WITH POSITIVE PARITY IN ^{169}Yb. Bondarenko, V. A.; Tamberg, Yu. Ya. (Inst. of Physics, Riga). Latv. PSR Zinat. Akad. Vestis, Fiz. Teh. Zinat. Ser.; No. 6, 11-19 (1969). (In Russian).

The odd-neutron nucleus ^{169}Yb was analyzed based on the data of (d,p), (d,t), (n,γ), (n,e$^-$) reactions and β-decay. The energetics of $3/2^+$ [651] and $3/2^+$ [642] rotational bands were investigated and the mixing of the bands was calculated. The energy anomaly in the $5/2^+$ [642] band is observed, which can be eliminated by incorporating a sign-changing member analogous to the decoupling parameter. An assumption is expressed that the anomalies in question are characteristic to rotational bands with positive parity in odd-neutron nuclei. (auth)

35892 HEAVIEST CHEMICAL ELEMENTS. Herrmann, Guenter; Seyb, Karl-Erich (Univ., Mainz). Naturwissenschaften; 56: 590-605(Dec 1969). (In German).

The production of transuranium heavy elements is reviewed. Reasons for the expectation of stability islands centered around the elements 114 and 164 are discussed. Also discussed are chemical properties of these new elements as well as their conceivable production methods. Worldwide state of building appropriate accelerators is outlined. 193 references are given. (H.B.G.)

35893 A STUDY OF SEVERAL ISOMERIC TRANSITIONS. Legrand, J.; Lagoutine F.; Brethon, J. P. (CEN, Saclay, France). Int. J. Appl. Radiat. Isotop.; 21: 139-42(Mar 1970). (In French).

The half-lives and internal conversion coefficients of the following isomeric transitions were measured: ^{99m}Tc: T = 6.031 ± 0.012 hr; ^{87m}Sr: T = 2.793 ± 0.009 hr, α_t = 0.211 ± 0.006, α_K = 0.177 ± 0.006; ^{113m}In: T = 1.658 ± 0.004 hr, α_t = 0.559 ± 0.014, α_K = 0.441 ± 0.013. (auth) (UK)

35894 CONVERSION ELECTRON INTENSITIES OF ^{177}Lu. Kartashov, V. M.; Troitskaya, A. G.; Shevelev, G. A. (Inst. of Nuclear Physics, Alma-Ata, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 34: 394-6(Feb 1970). (In Russian).

The spectra of internal conversion electrons accompanying the 155-day decay of the metastable state of ^{177}Lu were studied using a β spectrometer of $\pi\sqrt{2}$ type. The high resolving power of the device (0.12 to 0.06% for Hρ) revealed new data on the intensity of conversion lines in series of transitions taking place in ^{177}Lu and ^{177}Hf. (R.V.J.)

Nuclear Theory

Refer also to abstracts 35670, 35675, 35678, and 35686.

35895 (KAPL-P-3866) PHOTO NUCLEAR REACTIONS. Francis, N. C. (Knolls Atomic Power Lab., Schenectady, N. Y.). [nd]. Contract W-31-109-eng-52. 6p. Dep. CFSTI.

The use of the photon as a probe for the study of nuclear reaction and structure theory is considered. The meson photoproduction cross section of complex nuclei, giant dipole resonances, (γ,n) reactions, and neutron capture are briefly discussed. (L.W.A.)

35896 (KAPL-P-3867) PHOTO NUCLEAR REACTIONS AND INTERMEDIATE STRUCTURE. Francis, N. C. (Knolls Atomic Power Lab., Schenectady, N. Y.). [nd]. Contract W-31-109-eng-52. 7p. Dep. CFSTI.

The use of the photon for the study of nuclear reaction and intermediate structure theory is considered. Giant dipole resonance, (γ,n) reactions, and neutron capture are discussed. (L.W.A.)

35897 (TID-25391) NEUTRON EVAPORATION IN HEAVY ION INDUCED REACTIONS. Sperber, Daniel (Rensselaer Polytechnic Inst., Troy, N. Y.). Jul 1969. Contract AT(30-1)-3947. 5p. Dep. CFSTI.

A method for calculating the excitation function for the evaporation of a specified number of neutrons in heavy ion induced reactions in which fission competes with neutron evaporation is discussed. Reactions are treated in which the radiation width can be neglected in comparison with the neutron or fission width. (L.W.A.)

35898 NUCLEAR AND PARTICLE PHYSICS. Paul, E. B. London; North Holland Publishing Company (1969). 494p. 117s.

An introduction to the subject of nuclear and particle physics is presented under the following main headings: Nuclear properties; nuclear instability and decay; interaction of radiation with matter; detection and measurement of radiation; accelerators; nuclear reactions; reaction mechanisms; nuclear models (shell and collective); nuclear orientation; nuclear forces; fundamental particles (properties and classification); the weak interaction; miscellaneous topics (abundance of elements and nuclear synthesis, cosmic rays, controlled thermonuclear processes). Some problems are included on the foregoing topics. (UK)

35899 NUMERICAL APPROXIMATION TO FUNCTIONS AND DATA. Hayes, J. G. (ed.). London; The Athlone Press of the University of London (1970). 185p. 60s.

Among the subjects discussed are:- experience with cubic splines in the graduation of neutron cross-section data (Chap 9 Parker, K). Results following the use of several cubic-spline programs as aids in the evaluation of neutron cross-section data over a wide energy range are given. The complexity of the underlying physical laws make this a stringent test of cubic-spline methods. (UK)

35900 LIMITS FOR THE PERIODIC SYSTEM. Kuchowicz, B. (Univ. of Warsaw). Wszechswiat; No. 5, 119-20(1969). (In Polish).

One hundred and five chemical elements and about 1.5×10^3 radionuclides are known today. Recently some chemical elements occurring in nature which seemed to have natural stable isotopes are revealing their radioactivity (like Nd, Sm, Gd—though half-lives are of the order of 10^{11} y and larger). The possibility is discussed that the number of known nuclides is increasing, and that some natural limits to it are given. Such limits in the diagram of proton number vs neutron number are given as the lines for zero binding energy of the last neutron or proton. Unstable nuclides very close to these two lines may decay either by proton or by neutron radioactivity instead of beta decays. A further limitation which results in a small number of stable or long-living elements is spontaneous fission. Methods of nucleosynthesis which may lead to a formation of nuclides in the region between the valley of beta stability and the two lines are mentioned. Since the nuclides to be synthesized prove more unstable, rapid methods of identification (on-line) must be developed. (auth) (NSA of Poland)

35901 CALCULATION OF NUCLEAR COMPRESSIBILITY. Pandharipande, V. R. (Tata Inst. of Fundamental Research, Bombay). Phys. Lett., 31B: 635-6(11 May 1970).

Compressibility of finite nuclei is calculated by the constrained Thomas–Fermi method. It is found to be much lower than the infinite nuclear matter compressibility and its variation with A is well explained by the nuclear liquid-drop model. (auth)

35902 SELF-CONSISTENT CALCULATION OF THE ABSORPTION OF FREE PIONS FOLLOWED BY SINGLE-NUCLEON EMISSION. Kaushal, R. S.; Waghmare, Y. R. (Indian Inst. of Tech., Kanpur). Phys. Lett., 31B: 637-8(11 May 1970).

Using the Hartree–Fock model of the complex nucleus, the absorption of positive pions followed by the single-nucleon emission was studied. The agreement between the calculated and the available experimental differential cross sections is found to be satisfactory. (auth)

35903 EXISTENCE AND CONSEQUENCES OF A SCISSION BARRIER FOR HEAVY FISSIONING NUCLEI. Noerenberg, W. (Univ., Heidelberg). Phys. Lett., 31B: 621-3(11 May 1970).

Results are given of a static molecular model calculation on the existence of a scission barrier. Consequences of such a barrier on fission dynamics and on heavy ion scattering are discussed. The existence of new fission isomers is proposed. (auth)

35904 PROPERTIES OF THE MATRIX ELEMENTS OF THE EFFECTIVE INTERACTION DETERMINED BY A SEPARATION-CONDITION VARIATIONAL METHOD. Grypeos, M. E. (Univ. of Surrey, Guildford, Eng.). Nucl. Phys.; A141: 400-16(1970).

The variational approach with a separation condition, which was proposed in a previous paper with the aim of allowing for two-body correlations in finite nuclei, is further investigated. In particular, allowance is made for values of the Lagrange multiplier ϵ_{nlS} due to the "normalization condition" different from zero. In addition, the dependence of the matrix elements of the effective interaction on the separation distance and on ϵ_{nlS} is investigated. Numerical calculations of these matrix elements are performed, and comparison with values obtained with other methods is made. (auth)

35905 RELATIVISTIC EFFECTS IN K-ELECTRON EJECTION DURING K CAPTURE. Intemann, R. L. (Temple Univ., Philadelphia). Phys. Rev.; 188: 1963-4(20 Dec 1969).

An error in a previous work by the author is corrected. The corrected results show that relativistic effects have almost no influence on the shape of the energy spectrum of the K electrons ejected during nuclear K capture. They do, however, produce a substantial reduction in the ejected-electron intensity at low energies and in the total ejection rate per K-capture event. The discrepancies existing between the theoretical predictions and the various experimental results are discussed. (auth)

35906 VARIATION IN NUCLEAR-MATTER BINDING ENERGIES WITH PHASE-SHIFT-EQUIVALENT TWO-BODY POTENTIALS. Coester, F.; Cohen, S.; Day, B.; Vincent, C. M. (Argonne National Lab., Ill.). Phys. Rev., C; 1: 769-76(Mar 1970).

For any given two-body Hamiltonian, there exists a large class of unitarily equivalent Hamiltonians that lead to the same scattering phase shifts at all energies. The purpose of this paper is to exhibit typical saturation curves for reasonable equivalent potentials. The binding energy per particle changes by several MeV in either direction, and the saturation minimum shifts to higher or lower density as the binding increases or decreases. Softening the potential increases the binding. The separation approximation for the reaction matrix provides qualitative insight into these effects. Exact calculations start with simple local s-wave potentials with either a hard core or a Yukawa core. The binding energy per particle is calculated in the Brueckner approximation with self-consistent single-particle energies below the Fermi level. For examples unitary transformations that differ from the identity by a short-range operator of rank 2 and transformations induced by distortions of the radial scale are used. The latter class of transformations alters the core radius and produces potential terms that are linear in the square of the momentum. (auth)

35907 T = 0 PROTON–NEUTRON PAIRING CORRELATION IN N ≠ Z LIGHT NUCLEI. Wolter, H. H. (Univ., Muenster, Ger. Univ. of Texas, Austin); Faessler, A.; Sauer, P. U. Phys. Lett.; 31B: 516-19(13 Apr 1970).

The generalized HFB theory including T = 1 and T = 0 proton–neutron-correlations is applied to self-conjugate and non-self-conjugate nuclei in the sd and the beginning of the pf shell. It is found that T = 0 pairing dominates T = 1 pairing for N = Z. For N ≠ Z, T = 0 pairing occurs only if proton and neutron gaps are small. In such cases T = 0 and T = 1 pairing are about equal in strength. (auth)

35908 MODEL DEPENDENCE OF NUCLEAR MATTER BINDING ENERGY. Srivastava, M. K. (McMaster Univ., Hamilton, Ont.); Banerjee, P. K.; Sprung, D. W. L. Phys. Lett.; 31B: 499-502(13 Apr 1970).

The model dependence of the binding energy per particle in nuclear matter is studied by comparing the results obtained from the separable potentials of Mongan and Tabakin with those from their phase equivalent local potentials. The differences are significant only in the case of Tabakin's one term separable potential which gives about 5 MeV per particle less contribution to the binding energy at $k_F = 1.36$ fm^{-1} than the corresponding local potential. (auth)

35909 NUCLEAR OPTICAL MODEL AND WAVE PROPERTIES: BARRIER PENETRATION, REFLECTION, ABSORPTION, AND RESONANCE. Michaud, Georges (California Inst. of Tech., Pasadena); Scherk, Leonard; Vogt, Erich. Phys. Rev., C; 1: 864-87(Mar 1970).

A detailed study of the wave properties of the nuclear optical model is presented to elucidate the problem of barrier penetration by charged particles and to remove some of the mystique of optical-model calculations. The wave properties and the concomitant penetration are most straightforward for square wells, for which the resonance, reflection, and penetration are easily ascribed to separate factors. We show that the wave properties of more general diffuse-edge optical potentials achieve a similar simplicity by the construction of an equivalent square well (ESW) which has the same resonance, penetration, and absorption factors as the optical potential, but which differs in its reflection factor. A general construction of the ESW is given, and we apply it to the following problems: (1) the very narrow single-particle resonances of real optical potentials that occur at energies far below the Coulomb barrier, (2) the nuclear absorption cross sections in the presence of barriers, (3) the calculation of absorption cross sections at astrophysical energies (extreme barrier penetration) employing optical models fitted to data at higher energies, and (4) the value of the nuclear radius and sum-rule limits appropriate to the analysis of nuclear reactions. In some cases of extreme barrier penetration, the ESW fails to yield all the properties. For example, cases are described where the bulk of the absorption may attain in the distant "tail" of the imaginary term in the optical potential: The corresponding reaction rates can yield information about the behavior of the nucleus at distances much beyond the normal nuclear radius. (auth)

35910 STATIC COULOMB CORRECTION TO BETA DECAY ARISING FROM THE NUCLEAR CHARGE CHANGE: A NONPERTURBATIVE APPROACH. Halpern, Todd A. (Naval Ordnance Lab., Silver Spring, Md.). Phys. Rev., C; 1: 1928-38(Jun 1970).

Electron wave functions for nuclear β decay are derived which include exactly the effects due to the nuclear charge change at the instant of decay. Although these wave functions are of general interest for β-decay theory, the main motivation for this work is that the first-order (in the fine-structure constant α) static Coulomb charge-change correction to β decay comprises a large part (two thirds) of the total first-order radiative correction. The present work does not require a perturbation expansion in powers of α for this part of the radiative correction. It is thus particularly suited for an investigation of some problems with the radiative corrections which are directly, or which may be indirectly, related to such an expansion: (1) the validity of previous assumptions concerning the Z dependence of the radiative corrections to β decay, and (2) the comparison of the exact point-nucleus limit of this part of the radiative correction with the logarithmically divergent character of the first-order result. The first problem is treated in the present paper and the second will be given later. The two previous Z-dependence assumptions are found to be incorrect for the static Coulomb charge-change part of the radiative correction. (auth)

35911 APPROXIMATE INTERNAL CONVERSION COEFFICIENTS FOR OUTER-SHELL ELECTRONS. Dragoun, O. (Max-Planck-Inst. of Nuclear Physics, Heidelberg); Plajner, Z.; Schmutzler, F. Czech. J. Phys.; 20: 375-80(1970).

The recent extensive calculations of approximate internal conversion coefficients for N_8-N_7, O_1-O_7, P_1-P_5 and Q_1 atomic subshells are discussed. The physical approximation (point nucleus–Coulomb field) together with the corrections for finite nuclear size and atomic screening are described in some detail. A comparison with previous calculation and experiments is presented. Possible improvements of the screening correction are given. (auth)

35912 THE WEAK COUPLING MODEL APPLIED TO THE NUCLEI WITH A = 16 to 19. I. ENERGY LEVELS. Ellis, P. J.; Engeland, T. (Univ. of Michigan, Ann Arbor). Nucl. Phys.; A144: 161-90(1970).

Particle-hole states were formulated by coupling in J and T eigenfunctions resulting from diagonalization of $(sd)^{n_1}$ and p^{n_2}. A central particle-hole interaction is assumed and the results for the negative parity levels with A = 16 to 19 mostly compare well with experiment. In particular it is important to include three hole states in ^{17}O. The structure of the positive parity levels in mass-18 is discussed. (auth)

35913 EFFECT OF FINITE SIZE OF NUCLEI HAVING A MAGNETIC DIPOLE MOMENT ON THE BREMSSTRAHLUNG OF LONGITUDINALLY POLARIZED ELECTRONS. Kerimov, B. K.; Ablakulov, Kh. A. (Moscow State Univ.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 9, 97-104(1969). (In Russian).

Born approximation equations for differential cross section and a degree of circular polarization of bremsstrahlung emitted by longitudinally polarized electrons in a nuclear field with magnetic dipole moment was obtained taking into account the rms radius and the fourth moment of charge density distribution and nuclear magnetic moment. The influence of $\langle r^2 \rangle$ and $\langle r^4 \rangle$ on the spectrum of charged and magnetic bremsstrahlung was evaluated. (tr-auth)

35914 INFLUENCE OF THE ELECTRON CLOUD ON THE NUCLEAR QUADRUPOLE MOMENT. Nowak, W. (Univ. of Lodz, Poland). Acta Phys. Pol.; A37: 535-8(Apr 1970).

Using the Sternheimer procedure and the Loewdin–Appel

method for the calculation of atomic functions, the induced quadrupole moment and the energy of interaction between the electron cloud and the quadrupole moment for the Hartree field are calculated. (auth)

35915 BIREFRINGENT DISPERSION AND THE NUCLEAR QUADRUPOLE INTERACTION. Robinson, E. J. (New York Univ., N. Y.). Phys. Rev., A; 1: 1322-5(May 1970).

This paper is an addendum to a paper (NSA 23: 21410) by the author which presented a relation between the gradient of the electric field at the nucleus and dipole matrix elements. A scheme is suggested to take advantage of the result. (auth)

35916 NUCLEAR STRUCTURE THEORY. Irvine, J. M. (Schuster Lab., Manchester, Eng.). Phys. Bull. (London); 21: 149-52(Apr 1970).

A review is made of recent theories concerning problems of nuclear structure in stable configurations. The independent particle shell model, nuclear matter (an infinite uniform distribution of equal numbers of neutrons and protons in which the Coulomb interaction is ignored), finite and deformed nuclei and nuclear spectra, are discussed. It is concluded that the ground state energetics all the way from the deuteron to nuclear matter appear to be exhibiting a measure of agreement between theory and experiment. (UK)

35917 SOFT-CORE POTENTIAL MATRIX ELEMENTS IN A BASIS OF HARMONIC OSCILLATOR WAVE FUNCTIONS. Ulehla, I. (Charles Univ., Prague). Czech. J. Phys.; 20: 401-31(1970).

Methods of calculation of the soft core potential matrix elements in the space of the harmonic oscillator wave functions and their values for several frequencies of the oscillator are presented. The realistic soft core potential is used. It is a superposition of the Yukawa type potentials and fits to the two-nucleon data. (auth)

35918 SOME ASPECTS OF A SOLUBLE THREE-BODY PROBLEM. Levin, F. S. (Brown Univ., Providence). Nucl. Phys.; A144: 200-8(1970).

The wave function describing the scattering of two non-interacting, spinless particles by a center of force is studied using various methods of solution. It is demonstrated in some detail that use of the free, outgoing wave Green function leads to both ingoing and outgoing waves asymptotically for both the Lippmann–Schwinger solution, and for the Faddeev and multiple scattering solutions. Contributions from disconnected diagrams give rise to this result. It is also shown that each of the above methods of solution yields the trivial Schroedinger equation product solution. (auth)

35919 STUDIES IN j^n CONFIGURATIONS. Friedman, M. I.; Kelson, I. (Tel-Aviv Univ., Israel. Yale Univ., New Haven). Contract AT(30-1)3223. Nucl. Phys.; A144: 209-24(1970).

Model calculations are carried out in j^n configurations, investigating the emergence of collective-like spectra as a function of the number of particles and their spin. Particular attention is paid to the role of seniority in the description of such systems. (auth)

35920 FISSION: MASS ASYMMETRY AND SUPERCONDUCTIVITY. Gaudin, M. (CEN de Saclay, Gif-sur-Yvette, France). Nucl. Phys.; A144: 191-9(1970). (In French).

Using a very schematic model, it is shown how the nuclear superconductivity could help to explain the mass asymmetry characterizing the low-energy fission phenomenon. (auth)

35921 NEW EXPANSION OF THE PROJECTING OPERATOR IN ELLIOTT'S SU_3 SCHEME. Asherova, R. M.; Smirnov, Yu. F. (Moscow State Univ.). Nucl. Phys.; A144: 116-28(1970).

A new procedure for projecting wave functions with certain orbital angular momentum from internal wave functions in Elliott's SU_3 scheme was developed. This involves the use of the projection operator P^L_{KK} in Loewdin–Shapiro form. The formula for expanding the projected function over internal functions was obtained which makes it possible to connect the Clebsch–Gordan coefficients for the SU_3 group in the $SU_3 \supset R_3$ basis with the same coefficients in the canonical $SU_3 \supset SU_3$ basis. The calculation of matrix elements of the Hamiltonian and operator Ω introduced by Bargmann and Moshinsky is discussed. (auth)

35922 ENERGY DEPENDENCE OF THE REAL LOCAL POTENTIAL AND THE EFFECTIVE MASS NEAR ZERO ENERGY. Ahmad, I.; Rahman Khan, M. Z. (Aligarh Muslim Univ., India). Nucl. Phys.; A144: 7-16(1970).

The near constancy of the real local potential well depth around zero energy as noted by Brown et al., who suggested that perhaps it was a specific feature of the finiteness of actual nuclei, is shown to be due to the combined effect of the energy dependence arising due to the non-locality and the intrinsic energy dependence of the basic potential. The usual approach, and that of Feshbach, for introducing the effective mass for an energy dependent non-local potential are discussed and the latter is found to be more appropriate. An approximate condition is obtained under which near zero energy, an energy dependent non-local potential, gives a real local depth that increases with energy. (auth)

35923 MICROSCOPIC DESCRIPTION OF THE TWO-PARTICLE STRIPPING ON DEFORMED NUCLEI. Brandus, I. (Inst. of Atomic Physics, Bucharest); Dumitrescu, O.; Sandulescu, A. Rev. Roum. Phys.; 14: 959-79(1969).

A microscopic finite range approximation formalism for two-particle stripping reactions on deformed nuclei is developed. A new method for the calculation of the stripping matrix elements is given. The method is based on the expansion of the plane- or distorted-wave functions as a product of a Gauss function and an expansion in terms of harmonic oscillator wave functions. The exclusion principle is taken into account and the exchange contribution to the cross-section is obtained. A detailed treatment is given for the case of (α,d) stripping reactions on deformed nuclei. (auth)

35924 CERTAIN GENERALIZATION OF UNIFIED MODEL OF NUCLEI. Bravin, A. V.; Fedorov, A. D. (Saratov State Univ., USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 34: 454-9(Feb 1970). (In Russian).

The unified model described in published literature is used in calculations of kinetic energy for spherical or very slightly deformed nuclei. An attempt was made of expanding the unified model for calculations of kinetic energy for the case in which the equilibrium nuclear shape differs from spherical or its deviations from spherical are large. (R.V.J.)

35925 NUCLEAR MATRIX ELEMENTS OF β DECAY OF DEFORMED NUCLEI. Voikhanskii, M. E.; Voronkov, Yu. P. Izv. Akad. Nauk SSSR, Ser. Fiz.; 34: 444-8(Feb 1970). (In Russian).

Formulas were derived for calculating nuclear matrix elements for forbidden one-particle β transitions of deformed nuclei in the $Nn_z = \Lambda\Sigma$ quantum number concept. Formulas obtained were used in calculations with Nilssen potential functions and with wave functions of the Saxon–Woods potential. (R.V.J.)

35926 ISOSPIN MIXING IN THE GIANT DIPOLE RESONANCE OF SELF-CONJUGATE NUCLEI. Mahaux, C. (Univ., Liege); Saruis, A. M. Nucl. Phys.; A138: 481-513(1969).

Several characteristic features of the giant photonuclear dipole cross sections recently computed for ^{12}C, ^{16}O, and ^{40}Ca are exhibited and interpreted. They are related to the isospin impurity of the scattering wave functions in the internal region of the compound nucleus. Particular attention is paid to the shape of the cross section in the vicinity of $T = 0$ resonance states. It is shown that $T = 0$ states may produce deep minima in some photonuclear cross sections. This indicates that the channel wave functions may play an important role in the violation of the isospin purity in the giant resonances. The example of the giant dipole resonance in ^{16}O is treated in some detail. The physical interpretation of the results of coupled-channel calculations is discussed. It is shown how resonance energies and widths can be obtained. (auth)

35927 WAVE FUNCTION OF THE TRITON. Scarborough, James Anthony. Tucson, Ariz.; Univ. of Arizona (1969). 77p. Thesis.

The bound three-nucleon system is treated in an approach based on the method of K-harmonics. D-state angular momentum eigenfunctions are constructed and included in a nuclear wave function satisfying the generalized Pauli principle. The Hamiltonian contains central and tensor pair interactions. Both central and tensor forces may be spin-isospin-parity dependent, or both may be average effective forces depending only on the internucleon distances. A solvable system of second-order ordinary differential equations in one variable is derived for the radial parts of the total wave function. The system is solvable by standard computer methods for arbitrary finite potentials. (Diss. Abstr. Int., B)

35928 HYPERFINE EFFECTS IN RADIATIVE MUON CAPTURE. Guardiola, R.; Pascual, P. (Univ. of Valencia, Spain). Can. J. Phys.; 48: 1304-13(1 Jun 1970).

A general theory of partial radiative muon capture is presented, including the hyperfine effects. Use is made of the impulse approximation, neglecting the nucleon velocity-dependent terms. (auth)

35929 PCAC AND TRITON BETA DECAY. Blomqvist, J. (State Univ. of New York, Long Island). Phys. Lett.; 32B: 1-5 (25 May 1970).

The PCAC relation is used to derive the one-pion-exchange contribution to the allowed Gamow–Teller beta-decay operator. The transition matrix element is evaluated for the $^3H \rightarrow {}^3He$ de-

cay. The resulting correction is found to account for the difference between the experimental and the one-body matrix elements. The S–D cross terms give the main contribution. (auth)

35930 EVALUATION OF THE FERMI FUNCTION: E0 COMPETITION. Wilkinson, D. H. (Oxford Univ.). Nucl. Instrum. Methods; 82: 122–4(1970).

It is demonstrated that the usual Fermi function for beta-decay may be evaluated with great accuracy by elementary methods. Competition between electron emission and negaton-positon pair emission in electric monopole transitions is discussed and a figure for its rapid approximate assessment is given. (auth)

REACTOR TECHNOLOGY

Commercial Power Reactors

35931 (DOCKET-50003-45) INDIAN POINT STATION, UNIT NO. 1. Preparation for Repair of Primary Coolant Piping. (Consolidated Edison Co. of New York, Inc., New York). 8 Jul 1970. 6p. Dep. CFSTI.

In order to effect repairs to cracks in the 4-inch primary coolant piping, the No. 12 loop must be isolated. Design details of a special inflatable rubber plug for isolating the loop are presented. (H.D.R.)

35932 (DOCKET-50237-53) DRESDEN NUCLEAR POWER STATION, UNIT 2. Control Valve for Main Steam Line Isolation Valves: Operability Problem. HPCI Line Damage Report. (Commonwealth Edison Co., Chicago, Ill.). 6 Jul 1970. 7p. Dep. CFSTI.

During the Dresden 2 startup test program, the main steam isolation valves operated improperly on several occasions. Investigations of damage to the high pressure coolant injection system steam line indicated excessive hydraulic forces were responsible. Evaluations of these operational problems are presented. (H.D.R.)

35933 (DOCKET-50237-55) DRESDEN NUCLEAR POWER STATION, UNIT 2. Use of Furnace Sensitized Stainless Steel Components. (Commonwealth Edison Co., Chicago, Ill.). 9 Jul 1970. 7p. Dep. CFSTI.

The furnace sensitized stainless steel internal brackets and safe ends used in Dresden 2 are listed. The consequences of failure of the internal brackets are discussed. (H.D.R.)

35934 (DOCKET-50249-36) DRESDEN NUCLEAR POWER STATION, UNIT 3. Locations and Types of Vibration Sensors. (Commonwealth Edison Co., Chicago, Ill.). 9 Jul 1970. 2p. Dep. CFSTI.

35935 (EUR-4475) OPEN-VESSEL EXPERIMENTS ON PLUTONIUM PROTOTYPE ELEMENTS IN THE GARIGLIANO REACTOR. Ariemma, A.; Bramati, L.; Cammarota, U.; (and others) (Ente Nazionale per l'Energia Elettrica, Rome (Italy)). 1970. 68p. Dep. CFSTI (U. S. Sales Only). FF 11.-.

During the last shutdown of the Garigliano reactor for refueling (August-September 1968), a series of critical experiments were performed on assemblies containing reload enriched-U elements and prototype Pu elements. The outcome of these experiments was information on the rod power density distributions associated with highly heterogeneous lattices and reactivity variations following replacement of enriched-U elements with Pu elements. The technique used for power density measurements γ activity scanning by means of a NaI crystal) proved its outstanding capabilities, because it revealed minor effects on the power densities, such as those due to rod manufacturing tolerances. The good agreement observed in previous criticality experiments between the experimental values and those obtained with the calculation methods adopted by ENEL in the design of Pu prototype fuel elements was fully confirmed. The power density was calculated with a standard deviation less than 2%, and reactivity with an error below 0.5%. 8 references. (auth)

35936 (ZJE-58) ATOMIC POWER PLANT AT JASLOVSKE BOHUNICE. Patrovsky, V. (Skoda Concern, Pilsen (Czechoslovakia), Nuclear Power Plants Div.). Nov 1969. 30p. Dep. CFSTI (U. S. Sales Only).

Description and technical dates of the Bohunice Power Reactor Unit 1 are presented. The heavy water moderated and carbon dioxide cooled reactor is fuelled with natural uranium. The thermal power is rated at 560 MW, and the electrical power is rated at 144 MW (110 MW net). Siting is described. Scheme of the primary circuit is presented. The moderator circuit, pressure vessel, calandria, and control rods are described. (auth)

35937 BORSSELE NUCLEAR POWER PLANT (KCB). I. ECONOMIC IMPORTANCE, CONSTRUCTION, AND COMMISSIONING. Bogerd, T. (Provinciale Zeeuwse Energie-Maatschappij, Middelburg, Netherlands). Atomwirt., Atomtech.; 15: 226-8(May 1970). (In German).

Despite recent discoveries of large natural gas fields in the Netherlands, the energy requirements have increased to such a degree that development of nuclear power stations has become mandatory. Two power plants are presently under construction. The smaller one, of approximately 200 MW will become operational in mid 1971. The larger one, the Borselle nuclear power plant, of 477 MW(e) will begin operating in June of 1973. The reactors are of the pressurized water type. Site and state of construction are presented in five pictures. Additional power units are in the planning stage. (H.B.G.)

35938 SURVEY OF SWITZERLAND. Nucl. Eng. Int.; 15: 419-45(May 1970).

The development of the nuclear industry in Switzerland is reviewed. Research activities are described, with articles on reactor and fuel research at Wuerenlingen, and on the SIN ring cyclotron projects. Commissioning and operation of Beznau and design features of Muhleberg are described. Other topics discussed are the the activities of consulting engineers and the participation in nuclear projects of manufacturers of heavy electrical equipment, nuclear components, and steel castings. There are details of radiation monitoring equipment at Beznau and of a multiplex system for control and supervision of the CERN 28-GeV proton synchrotron. A folded chart shows the relationship between government bodies, industry, research and power projects. (UK)

35939 ESCOM PREPARES FOR NUCLEAR POWER. Colley, J. R. Nucl. Energy; 11: 82-3(May-Jun 1970).

Because of the great advances made in the last ten years, nuclear power today offers a reliable, competitive means of generating electricity in many parts of the world. This is borne out by the fact that 20 countries have 80 power reactors (totalling over 12,000 MW) in operation and a further 134 units (totalling over 80,000 MW) on order. This capacity involves an investment of the order of 13,000 million rads. The development of nuclear power plants in South Africa is described. (auth) (UK)

35940 STUDY AND CONSTRUCTION OF THE PRESTRESSED CONCRETE VESSEL OF THE NUCLEAR POWER STATION BUGEY I. Launay, P. (Compagnie Industrielle de Travaux, Paris). Ann. Inst. Tech. Batiment Trav. Publics; No. 269, 69-107 (May 1970). (In French).

The prestressed concrete vessel of the natural uranium fueled graphite moderated gas cooled Bugey Reactors (EDF-S) has prototype characteristics: the operating pressure is 45 bars for an inside diameter of the cylindrical cavity of 17.10 m. The upper slab has no transverse cabling because of the configuration of the standpipes unit which contains 950 shafts with only a minimum of space between them. The studies begun in 1964 involved various tests and experiments with two $\frac{1}{3}$-scale models. For the building of the vessel, heavy prefabrication of the metal parts incorporated to the structure was used. The prestressing of the structure required the tensioning of nearly 4500 t of cables. A great number of measuring devices should make it possible to control the behavior of the structure. (auth) (France)

35941 BEZNAU. Aemmer, F.; Albers, H.; Doron, Z. J. (Nordostschweizerische Kraftwerke AG, Baden, Switzerland). Nucl. Eng. Int.; 15: 429-31(May 1970).

Each of the 350 MW(e) units has a two-loop PWR and two turbogenerators. A list of main parameters and a brief outline of the more interesting features of the reactor are presented. Details of incidents occurring during commissioning, and problems overcome during initial operation of the first unit are recounted. (UK)

35942 TIHANGE NUCLEAR POWER STATION. Grandjean, Bernard (Electricite de France, Clamart). Ind. At.; 14: 33-40(1970). (In French).

The Tihange nuclear power station which is planned for operation by the end of 1974 is a Franco-Belgian realization. The site of the power plant and the arrangement of the various buildings are presented. The nuclear and thermodynamic characteristics of the P.W.R.-type reactor are given. The primary circuit and auxiliary circuits are described. Strict safety measures have been taken. The net electric power available at the 380 kV network will be 870 MW(e). (auth) (France)

35943 MUHLEBURG. Lutz, H. R. (Bernische Kraftwerke AG, Bern). Nucl. Eng. Int.; 15: 432-3(May 1970).

Unique features of the 300 MW(e) BWR station are double pressure suppression containment, charcoal filters in the offgas system, two turbosets and a 125 m stack. Illustrated descriptions are presented of the station layout, reactor building and the secondary coolant system. Also briefly described are output control and cooling water purification. Engineering parameters are listed. (UK)

35944 THE BORSSELE NUCLEAR POWER PLANT (KCB). II. TECHNICAL DATA, LAYOUT CRITERIA, AND DESCRIPTION.

Martin, A.; Pilgram, W. (Siemens AG, Erlangen, Ger.). Atomwirt., Atomtech.; 15: 229-32(May 1970). (In German).

In the Netherlands, the Borssele power station is presently under construction. It consists of a pressurized water reactor with a power of 1365 MW(t), and 477 MW(e). The steam pressure is 60 atm and the turbine works at 3000 rpm. Site and cross sections through the power station are presented in three pictures. Data about reactor core, pressure vessel, heat exchanger, cooling system, and safety systems are tabulated. The station is cooled by seawater and located in such a way that safe shutdown and cooling can be performed even if the dikes break and flooding occurs. (H.B.G.)

35945 NUCLEAR POWER PLANT CONTAINING AT LEAST ONE LIGHT WATER NUCLEAR REACTOR AND ONE HEAVY WATER NUCLEAR REACTOR. Margen, Peter Heinrich Erwin; Froman, Karl Goran Ernst (to Aktiebolaget Atomenergi). U. S. Patent 3,513,070. 19 May 1970. Priority date 16 Dec 1966, Sweden.

Partially burned-up fuel cartridges are transferred from a light water nuclear reactor to a heavy water nuclear reactor for a complete burn-up. The cartridges have a square or hexagonal cross-section, and they are placed in tubes having a circular cross-section in the heavy water reactor. Consequently, there will be heat insulating spaces between the cartridge and the tube, preventing an undesired heating of the moderator. (AEC)

35946 NUCLEAR POWER IN THE NORTHWEST. Broehl, Donald J. (Portland General Electric Co., Oreg.). pp 1.D.4.1-6 of Conference Record. Portland, Oreg.; Institute of Electrical and Electronics Engineers (1968).

From 6th IEEE Region Conference, Portland, Oreg. See CONF-680502.

The electric power generating system in the Pacific Northwest region of Oregon, Washington, Idaho, and western Montana is reviewed. Projections of load growth in the region are briefly discussed, and the advantages and problems associated with the introduction of nuclear power plants are examined. (H.D.R.)

Operation and Economics

Refer also to abstracts 33728, 35244, and 35999.

35947 (AI-AEC-12709) REPORT ON RETIREMENT OF HALLAM NUCLEAR POWER FACILITY. (Atomics International, Canoga Park, Calif.). 15 May 1970. Contract AT(04-3)-701. 387p. Dep. CFSTI.

A description of the Hallam Power Reactor is presented. Dismantling, isolating, and securing requirements and procedures are described. Responsibilities for the reactor retirement are outlined. (D.C.C.)

35948 (DOCKET-1155-39) LA CROSSE BOILING WATER REACTOR. Monthly Operating Report, February 1970. (Dairyland Power Cooperative, La Crosse, Wis.). 26 Jun 1970. Contract AT(11-1)-851. 20p. (DPC-851-4). Dep. CFSTI.

35949 (DOCKET-50003-44) INDIAN POINT STATION, UNIT NO. 1. Semiannual Operations Report No. 15, October 1, 1969-March 31, 1970. (Consolidated Edison Co. of New York, Inc., New York). 29 Jun 1970. 30p. Dep. CFSTI.

35950 (DOCKET-50016-41) ENRICO FERMI ATOMIC POWER PLANT, UNIT 1. Operations Report, March 1970. (Power Reactor Development Co., Detroit, Mich.). 2 Jul 1970. 11p. (PRDC-EF-79). Dep. CFSTI.

35951 (DOCKET-50213-47) CONNECTICUT YANKEE ATOMIC POWER PLANT. Operation Report No. 70-5, May 1970. (Connecticut Yankee Atomic Power Co., Haddam). 26 May 1970. Contract AT(30-1)-3250. 21p. (NYO-3250-48). Dep. CFSTI.

35952 (DOCKET-50220-46) NINE MILE POINT NUCLEAR STATION. Semiannual Report of Operation, August 23-December 31, 1969. (Niagara Mohawk Power Corp., Syracuse, N. Y.). 10 Jul 1970. 13p. Dep. CFSTI.

35953 (DOCKET-50244-44) ROBERT GINNA STATION, UNIT NO. 1. Semiannual Report No. 1, November 9, 1969-April 25, 1970. (Rochester Gas and Electric Corp., N. Y.). 24 Jun 1970. 54p. Dep. CFSTI.

35954 (DOCKET-50361-7) SAN ONOFRE NUCLEAR GENERATING STATION [UNIT 1]. Operation Report, May 1970. (Southern California Edison Co., Los Angeles. San Diego Gas and Electric Co., Calif.). Jun 1970. 7p. (NYO-3270-38). Dep. CFSTI.

35955 (GA-10099) 40-MW(E) PROTOTYPE HIGH-TEMPERATURE GAS-COOLED REACTOR POSTCONSTRUCTION RESEARCH AND DEVELOPMENT PROGRAM. Quarterly Progress Report for the Period Ending April 30, 1970. (Gulf General Atomic, Inc., San Diego, Calif.). 28 May 1970. Contract AT(04-3)-314. 51p. Dep. CFSTI.

FISSION PRODUCTS—distribution in Peach Bottom reactor fuel element graphite, (E)
GRAPHITE—radiation effects on hydrogen content of, neutron, (E)
INSPECTION—methods for control element guide tubes, in-vessel
—methods for thermal insulation of pressure vessels, in-vessel
NEUTRONS—effects on hydrogen content of reactor core graphite, (E)
NEUTRONS, FAST—effects on fracture strength of Peach Bottom reactor vessel steel, (E)
PEACH BOTTOM POWER REACTOR, UNIT 1—operation during February to April 1970
—physics measurements on Core 2 subcritical loading
—fuel elements for, removal of failed
—fuel elements for, in-vessel inspection of
—control elements for, in-vessel inspection and hot cell examination of guide tubes for
—reflector elements for, in-vessel inspection of
—pressure vessel for, in-vessel inspection of thermal barrier for
—fuel elements for, distribution of fission products in graphite of, (E)
—shutdown rod for, performance of thermally released, (E)
—pressure vessel for, fast neutron effects on fracture strength of, (E)
—cooling system of, removal and analysis of particulate matter from
—core for, radiation effects on hydrogen content of graphite in, (E)
PRESSURE VESSELS—radiation effects on fracture strength of Peach Bottom, fast neutron, (E)
REACTOR CONTROL ELEMENTS—guide tubes for, in-vessel inspection methods for
REACTOR FUEL ELEMENTS—cladding of gas cooled, fission product distribution in graphite, (E)
STEEL—radiation effects on fracture strength of, fast neutron, (E)
THERMAL INSULATION—inspection of pressure vessel, methods for in-vessel (H.D.R.)

35956 (NP-18299) AGESTA NUCLEAR POWER STATION. Annual Report, January 1-December 31, 1969. Persson, K. (Swedish State Power Board, Stockholm). 20 Apr 1970. 43p. (In Swedish). Dep. CFSTI (U. S. Sales Only).

The annual report for the Ågesta Reactor includes a discussion of the breakdown of the cooling system. Various technical and environmental control problems are discussed. (Sweden)

35957 (TRG-Report-1924) GAS-COOLED REACTORS, PERFORMING AND PROSPECTIVE. Bainbridge, G. R. (United Kingdom Atomic Energy Authority, Risley (England). Reactor Group). May 1970. 30p. Dep. CFSTI (U. S. Sales Only).

The experience in design, construction and operation of gas-cooled reactor power stations is reviewed. Reference is made to the gas-cooled reactor power stations already operating and under construction in Britain, France, Italy and Japan. Possible developments from these designs supported by the experimental work on high temperature reactors in the O.E.C.D. Dragon Project, U.K., Peach Bottom, U.S.A., and Julich, Germany, are discussed. (auth) (UK)

35958 FUTURE ROLE OF NUCLEAR ENERGY AS THE PRIMARY ENERGY SOURCE. Mandel, H. (Rheinisch-Westfaelisches Elektrizitaetswerk AG, Essen). Atomwirt., Atomtech.; 15: 220-5(May 1970). (In German).

Energy requirements of mankind are considered on a worldwide scale. Terrestrial sources of energy are considered inexhaustible, even if energy requirements rise exponentially. The type of energy utilized is determined by economic factors. Fossil energy sources will tend to increase in cost and become insufficient within the next century. Nuclear fission, and later fusion, as energy sources will become increasingly economical and prevalent. At the present time, a mixture of fossil and nuclear fuels is necessary. In the future, nuclear energy will be the pre-

dominant factor. The future of a nation is much more determined by solution of the energy problem and inventiveness than by natural resources. (tr-auth)

35959 ELECTRIC GENERATING PROSPECTS FOR NUCLEAR POWER. Benedict, Manson (Massachusetts Inst. of Tech., Cambridge). IEEE (Inst. Elec. Electron. Eng.), Spectrum; 7: No. 7, 24-30(Jul 1970).

The development of water cooled power reactors in the U. S. is reviewed. Economic factors regulating future power reactor development trends in the U. S. are analyzed. The effects of LMFBR development on power costs are predicted. (D.C.C.)

35960 FERMI 1: MUCH AT STAKE. Olds, F. C. Power Eng.; 74: No. 7, 35-7(Jul 1970).

The possible roles the Fermi Fast Breeder Reactor might have in the LMFBR development program are analyzed. The potential use of oxide fuel in the Fermi Fast Breeder Reactor is described. Alternatives for reactor applications are discussed. (D.C.C.)

Safety and Siting

35961 (DOCKET-1151-31) ELK RIVER REACTOR. Request for a Possession Only License. (Rural Cooperative Power Association, Elk River, Minn.). 15 Jun 1970. 3p. Dep. CFSTI.

35962 (DOCKET-50016-40) ENRICO FERMI ATOMIC POWER PLANT, UNIT 1. Sodium Water Reaction Incident, May 20, 1970. (Power Reactor Development Co., Detroit, Mich.). 22 Jun 1970. 60p. Dep. CFSTI.

Includes Appendix: Operating Manual for Sodium Transfer Tank System, by MSA Research Corp., Callery, Pa. for Power Reactor Development Corp., Monroe, Mich.

35963 (DOCKET-50016-42) ENRICO FERMI ATOMIC POWER PLANT, UNIT 1. Technical Specifications, Request for Authorization of Change No. 22. (Power Reactor Development Co., Detroit, Mich.). 1 Jul 1970. 6p. Dep. CFSTI.

A change in the specifications for the activity of stack effluents is requested. The change would lower the maximum allowable concentration halogens and particulates having half lives greater than 8 days by a factor of 200. (H.D.R.)

35964 (DOCKET-50029-119) YANKEE NUCLEAR POWER STATION. Operation Report No. 113, May 1970. (Yankee Atomic Electric Co., Westboro, Mass.). 22 Jun 1970. 9p. Dep. CFSTI.

35965 (DOCKET-50206-55) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. License Application, Amendment No. 18. (Southern California Edison Co., Los Angeles). 19 Jun 1970. 100p. Dep. CFSTI.

Revised core physics parameters are presented for Cycle 2 loading of plutonium oxide (PuO_2)-uranium oxide (UO_2) and uranium oxide (UO_2) fuel elements. Revised control rod insertion limits for Cycle 2 operation are described. (D.C.C.)

35966 (DOCKET-50213-45) CONNECTICUT YANKEE ATOMIC POWER PLANT. RCC Control Rod Vane Problem. (Westinghouse Electric Corp., Pittsburgh, Pa.). Jun 1970. 13p. Dep. CFSTI.

For Connecticut Yankee Atomic Power Co., Westboro, Mass.

35967 (DOCKET-50213-46) CONNECTICUT YANKEE ATOMIC POWER PLANT. Thermal Shield Flexure Support Problem. (Westinghouse Electric Corp., Pittsburgh, Pa.). Jun 1970. 20p. Dep. CFSTI.

For Connecticut Yankee Atomic Power Co., Westboro, Mass.

35968 (DOCKET-50219-78) OYSTER CREEK NUCLEAR POWER PLANT, UNIT NO. 1. Request for Wavier: Operations Supervisor Qualifications. (Jersey Central Power and Light Co., Morristown, N. J.). 30 Jun 1970. 2p. Dep. CFSTI.

35969 (DOCKET-50219-79) OYSTER CREEK NUCLEAR POWER PLANT, UNIT NO. 1. Reactor Vessel Internals Vibration Measurements. (Division of Reactor Licensing (AEC), Washington, D. C.). 13 Jul 1970. 1p. Dep. CFSTI.

35970 (DOCKET-50220-44) NINE MILE POINT NUCLEAR STATION. Provisional Operating License, Amendment No. 1. (Division of Reactor Licensing (AEC), Washington, D. C.). 26 Jun 1970. 4p. Dep. CFSTI.

Authorization to increase from 12500 curies to 25000 curies the quantity of sealed antimony-122, antimony-123, and antimony-124 sources is presented. (D.C.C.)

35971 (DOCKET-50220-45) NINE MILE POINT NUCLEAR STATION. Additional Leak Detection System and Biological Shield Analysis). (Niagara Mohawk Power Corp., Syracuse, N. Y.). 2 Jul 1970. 4p. Dep. CFSTI.

Information on a system to detect leakage within the primary containment and an analysis of the pressure effects resulting from safe end failures within the biological shield are presented. (H.D.R.)

35972 (DOCKET-50237-52) DRESDEN NUCLEAR POWER STATION, UNIT 2. Excessive Control Rod Insertion Times. (Commonwealth Edison Co., Chicago, Ill.). 26 Jun 1970. 2p. Dep. CFSTI.

35973 (DOCKET-50237-54) DRESDEN NUCLEAR POWER STATION, UNIT 2. Special Report of Incident, June 5, 1970. (Commonwealth Edison Co., Chicago, Ill.). 6 Jul 1970. 53p. Dep. CFSTI.

On June 5, 1970, an incident occurred at the Dresden 2 plant which was initiated by a spurious electronic signal in the reactor pressure regulator. A reactor scram and isolation occurred in the normal fashion and the nuclear process was completely secured. In the course of events, safety valves were cocked open slightly causing the drywell to fill with steam. Normal shutdown controls were established and a controlled vent to atmosphere was conducted through the standby gas treatment system. Comprehensive monitoring conducted both on and off-site showed that no measurable quantities of radioactivity were released to the site or to the environs. A chronology and a complete evaluation of the incident are presented. (auth)

35974 (DOCKET-50245-35) MILLSTONE NUCLEAR POWER STATION, UNIT 1. Advisory Committee on Reactor Safeguards Report on Review of Proposed Changes to Safe Ends. (Division of Reactor Licensing (AEC), Washington, D. C.). 25 Jun 1970. 4p. Dep. CFSTI.

35975 (DOCKET-50245-36) MILLSTONE NUCLEAR POWER STATION, UNIT 1. Notice of Availability of Statement on Environmental Considerations. (Division of Reactor Licensing (AEC), Washington, D. C.). 7 Jul 1970. 17p. Dep. CFSTI.

35976 (DOCKET-50250-26) TURKEY POINT PLANT, UNITS NO. 3 AND NO. 4. Preliminary Safety Analysis Report, [Amendment 20], Suppl. 20. (Florida Power and Light Co.). 26 Jun 1970. 147p. (DOCKET-50251-24). Dep. CFSTI.

Additional information on the design and operating characteristics of Turkey Point Units 3 and 4 are presented. (H.D.R)

35977 (DOCKET-50254-16) QUAD-CITIES STATION, UNITS 1 AND 2. Licenses Application, Amendment No. 11, Answers to Questions. (Commonwealth Edison Co., Chicago, Ill. Iowa-Illinois Gas and Electric Co., Davenport, Iowa). 16 Jun 1970. 150p. (DOCKET-50265-13). Dep. CFSTI.

Additional information is provided for Quad Cities Power Reactor Units 1 and 2 under the following subject headings: pressure vessel stress loading under blowdown conditions; in-service inspection program; effects of design basis accident on drywell components; engineered safeguards; radiation monitoring systems; hydraulic systems for control rod drives; stress and strain characteristics of pressure vessel support skirt; thermal stress analysis of spent-fuel pools; training schedules for reactor personnel; operation record requirements; personnel responsibilities; and startup tests schedule. (D.C.C.)

35978 (DOCKET-50254-17) QUAD-CITIES STATION, UNITS 1 AND 2. License Application, Amendment No. 11, Technical Specification. (Commonwealth Edison Co., Chicago, Ill. Iowa-Illinois Gas and Electric Co., Davenport, Iowa). 16 Jun 1970. 162p. (DOCKET-50265-14). Dep. CFSTI.

35979 (DOCKET-50254-18) QUAD-CITIES STATION, UNITS 1 AND 2. License Application, Amendment No. 11, Final Safety Analysis Report, Vol. 1. (Commonwealth Edison Co., Chicago, Ill. Iowa-Illinois Gas and Electric Co., Davenport, Iowa). 16 Jun 1970. 450p. (DOCKET-50265-15). Dep. CFSTI.

The amendment presented includes information on the following subject headings: site and environs; reactor design parameters; cooling system; containment systems; and engineered safeguards. (D.C.C.)

35980 (DOCKET-50254-19) QUAD-CITIES STATION, UNITS 1 AND 2. License Application, Amendment No. 11, Final Safety Analysis Report, Vol. II. (Commonwealth Edison Co., Chicago, Ill. Iowa-Illinois Gas and Electric Co., Davenport, Iowa). 16 Jun 1970. 500p. (DOCKET-50265-16). Dep. CFSTI.

The amendment presented includes information on the following subject headings: instrumentation and control; electrical systems; radioactive waste systems; auxiliary and emergency systems; turbine and condensate feedwater systems; structural design and shielding; conduct of operations; analysis of design basis accident; chimney release limits for site; and quality assurance programs. (D.C.C.)

35981 (DOCKET-50261-36) H. B. ROBINSON UNIT NO. 2. Likelihood and Consequences of Turbine Overspeed, Addendum A. (Carolina Power and Light Co., Raleigh, N. C.). 1 Jul 1970. 13p. Dep. CFSTI.

35982 (DOCKET-50261-37) H. B. ROBINSON UNIT NO. 2. Steam Pipe Break. (Carolina Power and Light Co., Raleigh, N. C.). Jun 1970. 95p. Dep. CFSTI.

On April 28, 1970, during hot functional testing, the section of steam pipe connecting the "C" main steam line to the safety valve failed. The failure was a 360° circumferential break which allowed the safety valve to be blown off. The escaping steam injured 7 men in the immediate area. Events leading up to the incident, a metallurgical examination of the broken pipe, a stress analysis of the failed valve nozzle, and the transient aspects of a steam pipe rupture are described. (H.D.R.)

35983 (DOCKET-50266-22) POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2. Preliminary Safety Analysis Report, Amendment 9. (Wisconsin Electric Power Co., Milwaukee. Wisconsin Michigan Power Co., Appleton, Wis.). 2 Jul 1970. 23p. (DOCKET-50301-19). Dep. CFSTI.

Descriptive material and procedural outlines are presented for personnel respiratory protection during situations of high concentrations of airborne radioactivity. (H.D.R.)

35984 (DOCKET-50266-23) POINT BEACH NUCLEAR PLANT, UNIT 1. License No. DPR-24; Proposed Facility Operating License. (Division of Reactor Licensing (AEC), Washington, D. C.). 17 Jul 1970. 11p. Dep. CFSTI.

35985 (DOCKET-50266-24) POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2. Safety Evaluation. (Division of Reactor Licensing (AEC), Washington, D. C.). 15 Jul 1970. 76p. (DOCKET-50301-20). Dep. CFSTI.

35986 (DOCKET-50269-15) OCONEE NUCLEAR STATION, UNITS 1, 2, AND 3. License Application, Amendment No. 13, Static Method of Seismic Analysis of Piping System. (Duke Power Co., Charlotte, N. C.). 5 Jun 1970. 55p. (DOCKET-50270-15; DOCKET-50287-12). Dep. CFSTI.

35987 (DOCKET-50269-16) OCONEE NUCLEAR STATION, UNITS 1, 2, AND 3. License Application, Amendment No. 13, Final Safety Analysis Report, Rev. 6. (Duke Power Co., Charlotte, N. C.). 22 Jun 1970. 180p. (DOCKET-50270-16; DOCKET-50287-13). Dep. CFSTI.

Analysis of fuel element deflection and stress due to coolant loss accident conditions and seismic stresses is presented. Seismic stress analysis for buildings and piping systems is included. Analysis of steam-line-rupture accident is presented. Electrical systems and engineered safeguards are described. (D.C.C.)

35988 (DOCKET-50285-24) FORT CALHOUN STATION, UNIT NO. 1. License Application, Amendment No. 18. (Omaha Public Power District, Nebr.). 26 Jun 1970. 200p. Dep. CFSTI.

Revised and additional information is presented under the following subject headings: water intake structures and tunnels; core physics; containment vessel penetrations; ventilation and component cooling systems; waste disposal systems; control element withdrawal incident transients; and engineered safeguards. (D.C.C.)

35989 (DOCKET-50289-24) THREE MILE ISLAND NUCLEAR STATION, UNIT 1. License Application, Amendment No. 13. (Metropolitan Edison Co., Reading, Pa. Jersey Central Power and Light Co., Morristown, N. J.). 25 Jun 1970. 65p. Dep. CFSTI.

Financial data on the owners of the Three Mile Island Power Reactor Unit 1 are given in support of the application for operating license. The 1969 Annual Reports for the Metropolitan Edison Company, the Jersey Central Power and Light Company, and the General Public Utilities are included. (D.C.C.)

35990 (DOCKET-50327-18) SEQUOYAH NUCLEAR PLANT, UNITS 1 AND 2. Provisional Construction Permit. (Division of Reactor Licensing (AEC), Washington, D. C.). 27 May 1970. 2p. Dep. CFSTI.

35991 (DOCKET-50331-23) DUANE ARNOLD ENERGY CENTER. Provisional Construction Permit. (Division of Reactor Licensing (AEC), Washington, D. C.). 22 Jun 1970. 5p. Dep. CFSTI.

35992 (DOCKET-50334-23) BEAVER VALLEY POWER STATION. Construction Permit. (Division of Reactor Licensing (AEC), Washington, D. C.). 26 Jun 1970. 5p. Dep. CFSTI.

35993 (DOCKET-50338-18) NORTH ANNA POWER STATION, UNITS 1 AND 2. License Application, Amendment No. 9. (Virginia Electric and Power Co., Richmond). 26 Jun 1970. 31p. (DOCKET-50339-18). Dep. CFSTI.

Revised and additional information concerning the containment isolation system and containment penetrations is presented. (D.C.C.)

35994 (DOCKET-50338-19) NORTH ANNA POWER STATION, UNITS 1 AND 2. Implementation of Provisions of National Environmental Policy Act. (Virginia Electric and Power Co., Richmond). 17 Jun 1970. 35p. (DOCKET-50339-19). Dep. CFSTI.

Information concerning the control and monitoring of chemical, radioactive, and thermal discharges from the reactors is presented. (D.C.C.)

35995 (DOCKET-50361-6) SAN ONOFRE NUCLEAR GENERATING STATION, UNITS 2 AND 3. Assignment of Docket Numbers. (Southern California Edison Co., Los Angeles. San Diego Gas and Electric Co., Calif.). 24 Jun 1970. 3p. (DOCKET-50362-6). Dep. CFSTI.

Power Reactor Development

Refer also to abstracts 33704 and 34920.

35996 LEAK-TIGHT SUPPORT FOR ROTARY SEAL PLUG. Gallo, Sabino; Marseille, Jacques; Morin, Bernard; Sauvage, Michel (to Commissariat a l'Energie Atomique). British Patent 1,192,901. 28 May 1970. Priority date 18 Jan 1968, France.

REACTORS, LIQUID METAL COOLED — core tank of sodium cooled, tracked leak tight support for rotary seal plug of (H.D.R.)

35997 NUCLEAR REACTOR UNITARY CONSTRUCTION ELEMENT. Fonteray, Pierre-Jean; Noel, Robert; Thome, Paul (to Commissariat a l'Energie Atomique). British Patent 1,192,350. 20 May 1970. Priority date 8 Mar 1968, France.

REACTORS, POWER — core for pressure tube type, sectional units for assembly of (H.D.R.)

35998 EVALUATION OF THE ANALYSIS OF HEAVY WATER MODERATED POWER REACTOR. 3. ANALYSIS OF THERMAL CHARACTERISTICS. Mochizuki, Hiroji (Kawasaki Heavy Industries, Ltd., Kobe, Japan); Sasaki, Takashi; Izaki, Takashi; Takitani, Koichi; Torii, Hiroyuki. FAPIG (Tokyo); No 52, 240-7 (Feb 1969). (In Japanese).

The thermal characteristics of CO_2 cooled heavy water moderated power reactors were analyzed. The effect of CO_2 gas pressure on the thermal characteristics was investigated, and in that case, the stream cross section of fuel channels, the diameter of pellets, channel height, and roughness of sheath tube surface and so on were taken into account. Thermal design was studied to determine the optimum condition of plants and to evaluate correctly the core performance under the real condition of operation. Optimum rod arrangement is calculated. The computer code for the calculation is explained, and the result of calculation is described. The result shows that when the calorific value of cluster fuel differs, the usual homogeneous arrangement is not adequate, and it is necessary to investigate the optimum rod arrangement. The uniform distribution of temperature in various parts can be materialized by the optimization of arrangement. The thermal characteristics of Zr-Cu alloy sheath tube were also studied, and the effects of the thickness of tube and the maximum temperature in use are summarized in comparison with the characteristics of Be tube. The thermal performance of Zr-Cu sheath deteriorates as the thickness increases. (NSA of Japan)

35999 AVR REACTOR AND THE DEVELOPMENT OF HIGH-TEMPERATURE GAS COOLED REACTORS IN WEST GERMANY. Mase, Kiyoshi (Fuji Electric Co. Ltd., Tokyo). FAPIG (Tokyo); No. 51, 180-5(Nov 1968). (In Japanese).

The development of the high-temperature gas cooled reactors of thorium thermal breeder type is proceeding steadily in West Germany; this type of reactors has some promising future, along with fast breeder reactors. The feature of high-temperature gas-cooled reactors in West Germany is the employment of spherical fuel in the form of pebble bed. The advantages of high-temperature gas cooled reactors in general are the possibility of very high coolant temperature, efficient in electricity generation, and low fuel cost due to the thorium cycle with a high conversion ratio. Then, the benefits from the utilization of pebble bed in the German reactors are the combined advantages of homogeneous and heterogeneous reactors, less requirement for the dimensions of fuel, and the feasibility of fuel exchange during operation. First, the research and development of high-temperature gas cooled reactors in West Germany is outlined. Then, the operation of the AVR reactor after criticality, and also fuel elements and safety, are described. Finally, the prototype and its extrapolation into a full-scale reactor of high-temperature gas cooled type, proceeding steadily at present, are explained. (NSA of Japan)

Kinetics and Dynamics

Refer also to abstract 36065.

36000 (ANL/EBR-14) BOW-V: A CDC-3600 PROGRAM TO CALCULATE THE EQUILIBRIUM CONFIGURATIONS OF A THERMALLY BOWED REACTOR CORE. EBR-II Project. Kucera, D. A.; Mohr, D. (Argonne National Lab., Ill. Argonne National Lab., Idaho Falls, Idaho). Jan 1970. Contract W-31-109-eng-38. 125p. Dep. CFSTI.

Thermal bowing of subassemblies in the core of a nuclear reactor can cause mechanical interactions between adjacent subassemblies. The BOW-V program calculates the equilibrium configurations of closely spaced, parallel beams (simulating the subassemblies) which are thermally distorted. Each beam has a limited-pivot support near its lower end. The beams can contact and thus mechanically interact with each other at their tops and at an intermediate level. Interference between the beams and a fixed grid below the pivot is also possible. The axial distribution of radial temperature gradients across the beams is arbitrary. The BOW-V model provides for the influence of bowing in one row of subassemblies on any other row in the reactor. All possible modes of bending are included, and each beam can have different moments of inertia above and below the pivot. The contact points have arbitrary compressibility. The model provides for thermal expansion of the lateral dimensions of the subassembly hex can at the intermediate contact point. The program determines the positions of free-pivoting (interacting, but unloaded) beams as well as the deflections of fully loaded beams. Equation derivations, input/output specifications, and FORTRAN listing are presented. The program is written for the CDC-3600 computer. A sample problem (EBR-II run 25) is included. (auth)

36001 (BNWL-1402) EBR-II DOSIMETRY TEST DATA ANALYSIS (REACTOR RUNS 31E AND 31F). McElroy, W. N.; Jackson, J. L.; Ulseth, J. A.; Simons, R. L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Jun 1970. Contract AT(45-1)-1830. 96p. Dep. CFSTI.

Data from the dosimetry test yield the result of 2.1×10^{15} n/cm^2-sec for the total flux level at EBR-II Row 2—midplane as measured in a dosimetry structural subassembly and at a stated reactor power of 50 MW. The value of 2.1×10^{15} n/cm^2-sec agrees to within ~10 to 15% with values based on reactor physics and power considerations and fuel burnup measurements. Previously reported larger differences are attributed mainly to use of incorrect cross sections data and in the stated value of low power for Run 25a. Results from a number of fast reactor tests require a reduction in previously reported EBR-II core spectral averaged cross section values of 25% for the ^{54}Fe(n,p) and 30% for ^{58}Ni(n,p) reaction to achieve consistency with results from fission reactions. Measured reaction rates were used to generate flux-spectra solutions for different radial and axial locations. For Row 2—axially, flux-spectral differences were observed between low and high power and between the edge and center of a structural subassembly. It is concluded that fission and nonfission flux monitors are necessary in experimental subassemblies to secure accurate flux and fluence data for materials irradiation tests in EBR-II. 31 references. (auth)

36002 (EUR-4470) PROCEEDINGS OF THE CONFERENCE ON ANALYSIS OF FEW ROD EXPERIMENTS IN REACTOR PHYSICS, JRC, ISPRA, ITALY, MAY 12-14, 1969. Tassan, S. (ed.) (European Atomic Energy Community, Brussels (Belgium). Center for Information and Documentation). Mar 1970. 123p. (In English and French). (CONF-690554). Dep. CFSTI (U. S. Sales Only).

A review of the status of development of few rod experiment programs for fast and thermal reactors is presented. Significant features of the experimental techniques are described. Theoretical models for interpretation of the experiments and comparison of results obtained under similar conditions in different laboratories are presented. Trends for future developments in few rod experiment programs are predicted. (D.C.C.)

36003 (ORNL-TM-2997) EXPERIMENTAL DYNAMIC ANALYSIS OF THE MSRE WITH ^{233}U FUEL. Steffy, R. C. Jr. (Oak Ridge National Lab., Tenn.). Apr 1970. Contract W-7405-eng-26. 28p. Dep. CFSTI.

Tests were performed on the Molten-Salt Reactor Experiment to determine the system time response to step changes in reactivity, the neutron-flux-to-reactivity frequency response, and the outlet-temperature-to-power frequency response. The results of each of these were found to agree favorably with theoretical predictions. The time response tests were performed with the reactor operating at 1, 5, and 8 MW and substantiated the theoretical predictions that following a reactivity perturbation the system would return to its original power level more rapidly at higher power levels than at lower power levels and was load-following at all significant power levels. A noisy flux signal (caused by circulating voids) hampered detailed comparison of the experimental results and theoretical predictions. Neutron flux-to-reactivity frequency-response measurements were performed using periodic, pseudorandom binary and ternary sequences. This type of test effectively prevented much of the random noise contamination of the neutron flux from entering the final analyses and gave results which contained little scatter. The results were in good agreement with the theoretical predictions and verified that for the MSRE, the degree of stability increases with power level. Outlet-temperature-to-power frequency-response measurements were compared with similar measurements made during operation with the ^{235}U fuel and verified that the basic thermal properties of the reactor system were essentially the same as expected. 11 references. (auth)

36004 (RT/FI-(69)50) RADIAL POWER DISTRIBUTIONS WITHIN THE PINS OF LIGHT WATER MODERATED UO_2/PuO_2 FUELLED LATTICES. De Coster, M. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)); Pistella, F. (Comitato Nazionale per l'Energia Nucleare [Bologna (Italy). Centro di Calcolo]). [1969]. 16p. Dep. CFSTI (U. S. Sales Only).

Radial power distributions were calculated by transport theory within the pins of a light water moderated lattice, UO_2 fueled and enriched to 4% of ^{235}U as well as of a similar lattice containing 3% of ^{235}U and 1% of ^{239}Pu. The results agree very well with the experimental values measured by counting the tracks produced by fission products in insulating materials. 9 references. (auth)

36005 (TID-25443) ANALYTICAL AND EXPERIMENTAL STUDIES RELATING TO THE SIMULATED START-UP OF IN-CORE THERMIONIC REACTOR SYSTEMS. Guppy, James Garfield (Arizona Univ., Tucson. Dept. of Nuclear Engineering). Jun 1970. Contract AT(04-3)-670. 192p. Dep. CFSTI. Thesis.

An analytical representation of a nuclear reactor containing in-core thermionic devices suitable for transient studies is formulated. The resulting model is applicable to situations involving substantial changes in system operating conditions, as would be experienced during startup transients. Neutron kinetics and heat transfer are represented by "nodal" descriptions. Contributions from all system regions of importance are retained to produce realistic transient response. The resulting set of equations is coupled to a digital computer integration routine to solve for the dynamic response. The thermionic converter physics is described by a complex iterative numerical scheme based on a diffusion approximation to the plasma processes. Other thermionic processes included are surface and Schottky effects, plus an accounting of the electrostatic sheaths present. The analysis is extended to include general application to thermionic diodes undergoing transients. The digital description of the reactor model is tested against a comparable analog computer simulation and shown to yield better accuracy. The complex thermionic analysis is compared to a simpler converter physics description and found to be far superior in predicting the electrical characteristics of the converter for large changes in operating conditions. The thermionic analysis is also compared with transient experimental diode data over wide ranges of converter operations and shown to produce excellent agreement. Application of the model to system startup is described for two postulated startup approaches encompassing either constant diode voltage or constant emitter temperature. This thermionic reactor model is shown to be very useful in obtaining insight and understanding into the overall system dynamic behavior during large changes in system operating con-

ditions. Furthermore, since the thermionic analysis can be decoupled easily from the system model, separate application to studies involving only transient diode operations may be accomplished. An important finding of these analytical studies is that under certain conditions, the results obtained, assuming an average and uniform description of the temperature distributions, especially for the emitter surface, may not be sufficiently accurate to represent all of the important aspects of diode transient behavior. Analytical studies involving the complete reactor model demonstrate that simple control methods may be adequate to produce very reasonable response during system transients. 32 references. (auth)

36006 (ZJE-73) ANALYSIS OF MULTI-PARAMETER SYSTEMS BY ANALOG COMPUTER. Hrstka, V.; Kallvoda, R. (Skoda Concern, Pilsen (Czechoslovakia). Nuclear Power Plants Div.). 1970. 11p. Dep. CFSTI (U. S. Sales Only).

The analysis of multi-parameter controlled systems by means of an electronic analog computer (differential analyser) is presented. Special care is devoted to non-standard solutions of problems from the field of control of nuclear reactors on an electronic analog computer. (auth)

36007 INVESTIGATION OF EFFECTIVE INELASTIC CROSS SECTION FOR FAST REACTOR COMPOSITIONS. Tone, Tatsuzo; Katsuragi, Satoru (Japan Atomic Energy Research Inst., Ibaraki). J. Nucl. Sci. Technol. (Tokyo); 7: 153-55(Mar 1970).

The elastic removal cross section, which is important for evaluation of Na-void effect for a large fast reactor, largely depends on the composition of the reactor and cannot be obtained accurately by the conventional method adopted in standard group-constant sets. The mechanism of slowing down of neutrons due to inelastic scattering by discrete levels is quite similar to that of elastic scattering. Moreover, because in the energy region of inelastic scattering there are also present many peaks of elastic scattering especially of light and medium nuclides, the spectrum therefore should be influenced significantly by the energy and composition. Examination of whether such circumstances should bring about the same results for inelastic scattering as for the elastic removal cross section is presented. (8 references) (auth)

Control Systems

36008 (BAW-10007(Suppl.1)) CONTROL ROD DRIVE SYSTEM TEST PROGRAM. (Babcock and Wilcox Co., Lynchburg, Va. Power Generation Div.). Jun 1970. 10p.

Additional information concerning design parameters and performance testing of control rod drives for pressurized-water power reactors is presented. (D.C.C.)

36009 (HPR-122) APPLICATION OF A NON-INTERACTING CONTROL SCHEME IN THE DIRECT DIGITAL CONTROL OF THE HBWR. Roggenbauer, H.; Romslo, K.; Griess, F. (Institutt for Atomenergi, Halden (Norway). OECD Halden Reaktor Prosjekt). Feb 1970. 49p. Dep. CFSTI (U. S. Sales Only).

The conceptual development and experimental demonstration of so-called non-interacting control are described. Several process variables of the HBWR plant normally controlled by conventional analogue PID-controllers, have intermittently been controlled in direct digital (PID) control mode. However, in this mode of control where several variables are controlled independently, the different process variables influence each other due to the inherent dynamics of the process. Because of these process interactions, which can in particular be observed when setpoint changes are introduced, it was assumed that improved control could be obtained through decoupling the interacting loops. Three loops of the plant which are believed to have the strongest inherent couplings were selected for the demonstration of a control system which minimizes interactions between control loops. The multivariable process is mathematically described by a P-canonical structure, controlled by an autonomization network also of P-canonical structure and located between the controllers and the process. Both the autonomization networks and the controllers are part of a digital control programme. The experimental tests showed that the system could not completely eliminate process interactions, but the maximum deviation of the influenced process variables were on the average reduced to 50% compared to the deviation observed during runs with PID-controllers. (auth)

36010 (ZJE-76) SOME ECONOMIC CONSIDERATIONS FOR OPTIMUM MULTIPLE-UNIT REDUNDANT SYSTEMS WITH REPAIRABLE UNIFIED CONTROLLERS. Drab, F. (Skoda Concern, Pilsen (Czechoslovakia). Nuclear Power Plants Div.). 1970. 13p. Dep. CFSTI (U. S. Sales Only).

An attempt has been made to solve the problem of an economic optimum controller redundancy. The problem concerns a repairable unified controller having two failure modes (fail safe, fail unsafe) specified by the economy and reliability parameters. On the base of this type of controller it is possible to design a fail safe control system for a plant, which is specified by the economic parameters. The optimum controller redundancy relations for two types of fail safe control systems were obtained. The problem is solved in the minimum control system total cost sense. The results of this problem are oriented on reactor control systems, especially on the applications of the small wire-programmed digital computer SADIC. (14 references) (auth)

36011 USE OF COARSE CONTROL RODS TO AXIAL SHAPING OF HEAT GENERATION. Hermansky, Bedrich (Technical Univ., Prague). Jad. Energ.; 16: 152-8(May 1970). (In Czech).

The possibility of using coarse control rods for the axial shaping of the axial heat generation in a fuel channel has been investigated with the aim of attaining the maximum coolant outlet temperature. The maximum admissible temperature of the surface or in the axis of the fuel element has been considered as a limiting factor. (8 references) (auth)

36012 COMPUTATIONAL METHOD OF FUEL OPTIMAL CONTROL IN REGULATOR SYSTEM. Lee, Bong Jin (Korea Inst. of Science and Tech., Seoul). J. Korean Nucl. Soc.; 1: 79-85(Dec 1969).

The original minimization problem for a regulator, (fuel optimal control such as for reactors, internal combustion engines, chemical processes, and boilers) is converted to a two-point boundary value problem. This is put into integral form and reduced to a nonlinear vector relation (or operator): i.e., the problem can be solved once the initial costate vector is found. The vector relation is replaced by a sequence of approximate vector operators. A method is designed for choosing the sequence so that Newton's method can be applied to it and approached as closely as desired to the true solution. The procedure consists of applying Newton's method sequentially to the sequence of approximate operators to determine their solution vector. These vectors lead to a sequence of approximate control which converges to the optimal control. (auth)

36013 ADAPTIVE CONTROL CONCEPT OF REACTOR POWER DISTRIBUTION. Hoshino, Tsutomu (Kyoto Univ.). J. Nucl. Sci. Technol. (Tokyo); 7: 321-2(Jun 1970).

A computer control system concept which accommodates in a compromise the power distribution requirements of both the optimum fuel burnup scheme and the power plant load demand is described. (H.D.R.)

Shielding

36014 IMPROVEMENTS IN AND RELATING TO REACTOR CONTAINMENT VESSELS FOR FAST REACTORS. Schaller, Karl (to Commissariat a l'Energie Atomique). British Patent 1,195,819. 24 Jun 1970. Priority date 6 May 1968, France.

REACTOR CONTAINMENT STRUCTURES—roof for fast liquid sodium cooled, design of
REACTORS, FAST—containment structure for liquid sodium cooled, design of roof for
REACTORS, LIQUID METAL-COOLED—containment structure for fast, design of roof for (D.C.C.)

36015 SPEKTRY BYSTRYKH NEITRONOV ZA MATERIALAMI I KOMPOZITSIYAMI ZASHCHITY YADERNYKH REAKTOROV. ATLAS. (Fast Neutron Spectra Penetration in Various Materials of Nuclear Reactor Shielding. Atlas). Veselkin, A. P.; Egorov, Yu. A.; Emel'yanov, I. Ya.; Orlov, Yu. V.; Pankrat'ev, Yu. V. Moscow; Atomizdat (1970). 212p.

Spectra for fast neutron penetration of W-W reactors were measured with 100 different materials and shielding structures. Attenuation functions and the length of flux relaxation were found for eight energy groups of fast neutrons. In addition to the graphical data, methods of measuring various regularities in formation spectra for fast neutrons passing through the shielding are given. (42 references) (R.V.J.)

Cooling Systems

Refer also to abstracts 33959 and 33960.

36016 (GEAP-10143) REACTOR PRIMARY COOLANT SYSTEM RUPTURE STUDY. Quarterly Progress Report No. 19,

October–December 1969. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). Jan 1970. Contract AT(04-3)-189. 46p. Dep. CFSTI.

INCONEL—crack growth in pipes of, effects of stress and temperature on
PIPES—failure of carbon steel, probability analysis for
—failure in carbon steel tee and elbow, effects of stress and temperature on
—crack growth in Type 304 stainless steel elbow
—failure of Type 304 stainless steel, inconel, and carbon steel, analysis of low cycle fatigue
REACTORS—cooling system of, probability analysis for failure in pipes for
REACTORS, BOILING—cooling system of, low cycle fatigue testing of steel pipes for
STAINLESS STEEL—crack growth in elbow shaped pipes of Type 304, effects of stress and temperature on
STEEL—crack growth in tee and elbow shaped pipes of carbon, effects of stress and temperature on
WELDS—crack growth in Type 304 stainless steel and carbon steel pipe, analysis of low cycle fatigue (D.C.C.)

36017 (ORNL-TM-3002) REACTOR POWER MEASUREMENT AND HEAT TRANSFER PERFORMANCE IN THE MOLTEN SALT REACTOR EXPERIMENT. Gabbard, C. H. (Oak Ridge National Lab., Tenn.). May 1970. 32p. Dep. CFSTI.

The operating power of the MSRE was routinely determined by a heat balance on the fuel and coolant salt systems performed by the on-line computer. This gave a calculated full-power level of 8.0 MW. However, changes in the isotopic composition of uranium and plutonium in the fuel salt indicated a power lower than the 8 MW by about 7–10%. Attempts to resolve this discrepancy included a measurement of the coolant salt flow rate by the radioactive decay of activation products in the coolant salt, a recalculation of the coolant system pressure drop, and a heat balance on the air side of the coolant radiator. These efforts were inconclusive, but the coolant salt flow rate was found to be the only potential source of significant error in the heat balance. A calibration check of the differential pressure cells reading the coolant flow venturi is planned during scheduled post-operation examinations. The heat-removal capabilities of the fuel salt to coolant salt heat exchanger and coolant salt to air radiator were below the predictions of the original design calculations and limited the full-power output of the MSRE. In the case of the primary heat exchanger, the overestimate was due to the use of erroneous, estimated physical property data, the thermal conductivities in particular, for the fuel and coolant salts. When accurate, measured values of physical properties were used with the heat transfer relationships for conventional fluids, the calculated performance of the primary heat exchanger agreed with the observed value. In the case of the radiator, the overestimate in the design was only partially explained by the improper selection of an air "film" temperature. There was no decrease in heat transfer capability of the two heat exchangers over more than 3 years of operation. 16 references. (auth)

36018 (ZJE-59) INVESTIGATION OF RESISTANCE OF PRESSURE VESSELS OF NUCLEAR REACTORS TO BRITTLE FRACTURES. Kalna, Karol (Skoda Concern, Pilsen (Czechoslovakia). Nuclear Power Plants Div.). Dec 1969. 32p. Dep. CFSTI (U. S. Sales Only).

Strength problems in reactor pressure vessels are analyzed. Strength diagram of the low-carbon steels is included. Loading device ZZ 8000 is described. Description of the crack-arrest test is presented. Size factor in static tensile test is analyzed. (10 references) (auth)

36019 GRAPHITE MODERATOR AND GAS CLEANING OF THE AGR GAS-COOLED REACTOR. Kley, Hermann (Brown, Boveri and Cie, Mannheim, Ger.); Prince, Norman. BBC-Nachr.; 51: 108-14(Feb 1969). (In German).

The reactor AGR is cooled by CO_2 and moderated by graphite. High neutron flux and γ radiation as well as corrosion by CO_2 severely affect the graphite moderator. Development of isotropic graphite is described which will operate in the AGR reactor at approximately 1600 MW(t) throughout the entire lifetime of the reactor estimated at 30 years. Corrosion of the moderator can be minimized by addition of methane to the cooling CO_2. (tr-auth)

36020 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. (to SNAM Progetti SpA). British Patent 1,193,815. 3 Jun 1970. Priority date 8 Mar 1968, Italy.

REACTORS, FAST—core chamber for liquid sodium cooled, description of metal ring sealed
REACTORS, LIQUID METAL-COOLED—core chamber for fast, description of metal ring sealed (D.C.C.)

36021 IMPROVEMENTS IN AND RELATING TO A COLD TRAP WITH A FILTER. Le Jannou, Jean-Pierre; Lions, Noel (to Commissariat a l'Energie Atomique). British Patent 1,192,709. 20 May 1970. Priority date 20 Oct 1967, France.

REACTORS, FAST—cooling system for liquid sodium cooled, description of cold trap with filter for
REACTORS, LIQUID METAL-COOLED—cooling system for power, description of cold trap with filter for
TRAPS—design parameters of liquid sodium cold, with stainless steel wool filters (D.C.C.)

36022 IMPROVEMENTS IN OR RELATING TO PRESTRESSED CONCRETE PRESSURE VESSELS. Burrow, Reginald Edwin Downton; Morris, David Austin (to Taylor Woodrow Construction Ltd.). British Patent 1,191,973. 13 May 1970. Filed 4 Apr 1968.

Reference is made to concrete pressure vessels such as are employed for housing nuclear reactors. In current designs the aim has been to increase the number of standpipe and control rod penetrations, resulting in a decreased distance between the penetrations in the cap structure; it has been found, however, that if the distance between such penetrations is reduced below about 4 in. satisfactory placing of the concrete between them is very difficult. The object of the arrangement described is to provide an improved cap structure which will allow the standpipe pitch to be decreased without impairing the integrity of the cap structure. To this end it is proposed that the cap shall comprise a honeycomb or cellular steel structure providing passageways from standpipes and control rods. The passageways may be arranged so that an annular interspace is provided between the outer surface of the standpipe and the inner surface of the passageway, this arrangement being such that coolant may flow through, or insulating medium may be accommodated in, the interspace. The honeycomb structure may be encased in a casing of steel having rings or projections to facilitate keying or anchorage to the pressure vessel. (UK)

36023 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. Taylor, Peter Anthony (to Babcock and Wilcox Ltd.). British Patent 1,193,259. 28 May 1970. Filed 23 Sep 1966.

Reference is made to gas cooled reactors, employing concrete pressure vessels. In the system described a second chamber is provided within the pressure vessel and a duct is provided for leading coolant from the reactor core to this chamber. The outlet from the duct is arranged to provide for two heat exchangers located end-to-end in a single flow path in the chamber so that tubes of the first heat exchanger lie within the space extending towards one end of the chamber from the outlet and tubes of the second heat exchanger lie within the space extending towards the other end of the chamber from the outlet. Conduit is provided for leading part of the coolant discharged from the outlet into the flow path upstream of the first heat exchanger and part of the coolant into the flow path downstream of the first heat exchanger. By arranging that only part of the coolant flowing over the second heat exchanger also flows over the first heat exchanger is reduced, allowing reduced cost for installing and running the pumping plant. The location to which coolant is discharged downstream of the first heat exchanger may lie upstream of the second heat exchanger. A control means is described for varying the ratio between the part of the coolant discharging into the flow path upstream of the first heat exchanger and the part of the coolant discharging into the flowpath downstream of the first heat exchanger. Several variants of the system are described. (UK)

36024 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTOR PRESSURE VESSELS HAVING THERMAL INSULATION. Robson, Arthur Gray (to Nuclear Power Group Ltd.). British Patent 1,194,333. 10 Jun 1970. Filed 20 Jun 1966.

In the case of prestressed concrete pressure vessels for nuclear reactors, the insulation usually consists of thin metal sheets spaced by protuberances on the sheets or by metal spacers in the form of wire netting or wire mesh. Practical considerations usually require that the fluid in the interior of the vessel has limited access to interspaces in the insulation, so that the fluid pressure inside the insulation is close to that inside the vessel. It is desirable to keep fluid flow within the interspace to a minimum on thermal conductivity grounds, and, to minimize gas movement within the insulation under pressure, it is customary to overlap the metal sheets and introduce metal-to-metal seals between the sheets. Due to flexibility of the sheets and any geometrical irregularities in the structure to which the insulation is attached, leakage can still occur through the seals, with drastic reduction of the efficiency of the in-

sulation. All-metal insulation is also costly and not easy to install. In the system described the thermal insulation is formed from superposed sheets, with spacers separating the sheets so as to form interspaces to which fluid from the interior of the vessel has access. The sheets and/or the spacers are of non-metallic material, and means are adopted for compressing the spacers to an extent sufficient to restrict the flow of fluid in and between the interspacers and to achieve a desired degree of insulation, whilst permitting reduction of pressure differentials. The non-metallic spacer members may be of inorganic material, natural or synthetic fiber or any compressible material that is impermeable or of low permeability and capable of forming a good seal. This material may be in the form of sheets, blankets, strips, interlaced structure, perforated sheets, or honeycomb or grid-like structures. Wire reinforcement may be used, and the surfaces of the spaced numbers may be metallized. Wire mesh may also be interposed between one or more layers of non-metallic sheets interposed between two adjacent plane metal sheets, and a force applied to the insulation so that the wires locally compress the non-metallic material to form restriction to flow in the interspace between sheet-members. The metallic sheets may be plane or ribbed, dimpled or corrugated. Instead of using separate spacers members the spacer and sheet members may be formed integrally, the spacer members taking the form of protuberances formed in the sheet members. The insulation may be attached to the pressure vessel wall by studs and nuts. The insulation may be arranged as adjoining panels, or as overlapping panels the joints between adjacent panels being filled with a compacted fibrous compressible material. Cover plates can be fitted to the surface of the insulation to cover the joints between the panels, and a metallic or dimpled sheet may be located between the insulation and cover plates to provide additional compressibility to components for any dimensional inaccuracies in the cover plates and inner surface of the structure. (UK)

36025 TRANSIENT TEMPERATURE DISTRIBUTION IN WALLS EXPOSED TO GAMMA RAYS DURING HEATING-UP OF A NUCLEAR POWER PLANT. Eberwein, Josef (Siemens Aktiengesellschaft, Erlangen, Ger.). Nucl. Eng. Design; 12: 185-206(1970).

The general mathematical development of formulas for the calculation of the transient temperature distribution in a reactor vessel wall during a linear heating-up of a nuclear power plant, whereby heat is also generated within the steel wall by gamma ray energy deposition, is presented. The functions found were evaluated and plotted in diagrams as a function of the Fourier number, so that the temperature distribution of the desired time periods until the steady state condition may be calculated rapidly. From these results the critical temperature field within the steel wall and consequently the maximum mechanical stresses can be determined. (auth)

36026 DETERMINATION OF HYDROGEN IN SODIUM COOLANT. Kopylov, V. S.; Korotaeva, M. N.; Konovalov, E. E. At. Energ. (USSR); 28: 241(Mar 1970). (In Russian).

Analytical control of coolant content of hydrogen in the form of hydride and hydroxide was considered for nuclear reactors with Na-water vapor generators, due to the possibility of water leaking into the sodium. The problem was concerned with determining the two forms of hydrogen (H^- and OH^-). The method consisted of determining the content of hydrogen and hydrate in the two parallel sodium specimens. The obtained results were used for evaluating the H_2 content in the NaOH specimens. (R.V.J.)

36027 MASS AND HEAT EXCHANGE BETWEEN ADJACENT CHANNELS IN LIQUID-COOLED ROD BUNDLES. Van der Ros, T.; Bogaardt, M. (Eindhoven Univ. of Tech., Netherlands). Nucl. Eng. Design; 12: 259-68(1970).

Single-phase liquid energy-exchange experiments were carried out in (1) a transparent test section containing two adjacent simplified reactor subchannels at low pressure and (2) a high pressure rig with a test section consisting of four heated cluster elements close to average PWR operating conditions. The amount of mixing was determined by measuring the enthalpy increase. The data were analyzed by the eddy diffusivity approach. By means of the Prandtl mixing length theory an analytical explanation was obtained for the fact that the mixing coefficient is roughly inversely proportional to the gap width, as reported by many experimental investigators. The data from both test sections, when compared with existing mixing correlations, appear to be in much better agreement than when correlated with a Péclet number. (17 references) (auth)

36028 DYNAMIC BEHAVIOR OF A WATER-COOLED BOILING CHANNEL WITH TWISTED TAPES. Schoeneberg, R.; Ernst, H. (AEG-Telefunken, Frankfurt am Main). EURATOM-AEG-SNECMA 104-66-9 TEEC. Nucl. Eng. Design; 12: 249-58 (1970).

To predict the dynamic behavior of a boiling water reactor constructed with twisted tapes in the boiling channels, many steady state and dynamic tests were performed with this new type of boiling channel at the Stability Loop of AEG. The steady state measurements comprised slip correlations and two phase friction factors which must be known for the theoretical calculation of the dynamic void fractions. These local and total void fractions were measured disturbing sinusoidally either the heat power or the mass flow. The frequency responses of the pressure drop were measured for both types of disturbances, also. To simulate the situation of a "hot channel" in the reactor, which is encircled by the greater part of relative "cold channels" with nearly constant pressure drop, the void response was measured disturbing the power, with the condition of constant pressure drop over the whole test section. Constant pressure drop was achieved by a control circuit acting on the flow modulation valve. All experimental results were compared with calculations done with HYKAMO, a newly developed digital program. The main features of this model are: (1) the introduction of damping factors, a temperature disturbance in the subcooled region or a void disturbance in the boiling region travel with decreasing amplitude through the channel, and (2) the introduction of flow dependent slip ratios. The overall agreement between the experimental and theoretical frequency responses found was very satisfying. (auth)

36029 COMPARISON OF DIFFERENT COOLING SYSTEMS FOR A 600 MWe NUCLEAR POWER PLANT WITH HIGH TEMPERATURE REACTOR AND HELIUM TURBINE. Foerster, S.; Schroeder, B. (Kernforschungsanlage, Juelich, Ger.). Brennst.-Waerme-Kraft; 22: 232-8(May 1970). (In German).

For a 600 MW(e) nuclear power plant with high temperature reactor and helium turbine (direct cycle) the possibilities for the application of different water and air cooling systems and of the direct air cooling system are examined on economic aspects. The capital costs and the power generating costs of the different cooling systems, depending on their operational conditions are compared. The influences of an intermediate cooling water cycle and of one or two intercoolings in the gas turbine cycle are investigated. The operational and economic differences of water cooling systems for equivalent steam power plants are established. In the critical examination of the different cooling systems the safety aspects are included. 2 references. (auth)

36030 IMPROVED PRESSURIZER MODEL WITH BUBBLE RISE AND CONDENSATE DROP DYNAMICS. Nahavandi, Amir N. (Newark Coll. of Engineering, N. J.); Makkenchery, Suresh. Nucl. Eng. Design; 12: 135-47(1970).

The dynamic prediction of pressurizer performance in a pressurized water nuclear power plant can be improved by incorporating the bubble rise and condensate drop velocity concepts. The pressurizer is divided into two stratified elements separated by a water vapor interface. The bottom element contains subcooled or boiling liquid and the top element contains superheated or condensing vapor. Bubbles forming in the bottom element rise and enter the top element after an appropriate transport delay. Condensate forming in the top element falls and enters the bottom element after an appropriate time lag. Using this mass exchange concept and applying the equations of continuity, energy and steam-water properties for top and bottom elements combined with the pressurizer pressure control features, a comprehensive analytical model is developed. The predictions of this mathematical model are in good agreement with available data on the Shippingport pressurizer performance. Unlike previous pressurizer models, this improved model provides unique solutions and does not require changing the interface evaporation and condensation coefficients to match the experimental data. (auth)

Fuels

Refer also to abstracts 33639, 33760, and 36065.

36031 (EUR-4472) FINITE-ELEMENT ANALYSIS OF RADIATION-DAMAGE STRESSES IN THE GRAPHITE OF MATRIX FUEL ELEMENTS. Donea, J. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). 1970. 18p. Dep. CFSTI (U. S. Sales Only). EUR FF 4,45.

A finite-element procedure is presented for the determination of the radiation damage stresses in the graphite of matrix fuel elements. The assumption of a generalized plane strain situation is made. The graphite is assumed to be transversely isotropic. Irradiation induced creep as well as radiation damage and thermal

strains are taken into account by using an incremental type of analysis. 4 references. (auth) (EURATOM)

36032 (WAPD-TM-961) CYGRO-3: A COMPUTER PROGRAM TO DETERMINE TEMPERATURES, STRESSES AND DEFORMATIONS IN OXIDE FUEL RODS (LWBR DEVELOPMENT PROGRAM). Duncombe, E.; Friedrich, C. M.; Fischer, J. K. (Bettis Atomic Power Lab., Pittsburgh, Pa.). Mar 1970. Contract AT-11-1-GEN-14. 86p. Dep. CFSTI.

The CYGRO-3 computer program is an updated version of CYGRO-2. Time-dependent stresses and deformations are calculated for oxide fuel rods as a result of a history of power, coolant pressure and temperature etc., assuming axial and circumferential uniformity. Major changes are the incorporation of void migration, fuel cracking, fuel-clad interaction if the clad is collapsed, effect of loads at the rod supports, effect of neutron flux on creep, clad anisotropy, first order calculation of bending moments and deflections caused by nonuniform power distribution across fuel rod, and dynamic relations for hardening and recovery. Provisions are also made for use of the Bettis input data package for easy specification of input, together with options regarding repetition of history data for cyclic operation, and optional suppression of some output data. This computer program was developed as part of the LWBR development program. 9 references. (auth)

36033 (WCAP-3385-23) SAXTON PLUTONIUM PROJECT. Quarterly Progress Report for Period Ending March 31, 1970. Smalley, W. R. (Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.). May 1970. Contract AT(30-1)-3385. 35p. Dep. CFSTI.

NEUTRONS—effects on mechanical properties of Zircaloy-4, (E)
PLUTONIUM—utilization in pressurized water reactor fuels, (E/T)
PLUTONIUM OXIDES PuO_2—PuO_2–UO_2, radiation effects on burnup, microstructure, and mechanical properties of pressurized water reactor fuels of, in-pile, (E)
REACTOR FUEL ELEMENTS—performance of Zircaloy-4 clad mixed oxide, in pressurized water reactors, (E/T)
—cladding of pressurized water, corrosion film and crud formation on Zircaloy-4
REACTORS, PRESSURIZED WATER—fuel elements for, performance of Zircaloy-4 clad mixed oxide, (E/T)
—fuels for, utilization of plutonium in, (E/T)
SAXTON POWER REACTOR—fuel elements for, in-pile performance of Zircaloy clad plutonium oxide (PuO_2)–uranium oxide (UO_2), (E/T)
—operation of, at-power physics testing of Core III during
URANIUM OXIDES UO_2—PuO_2–UO_2, radiation effects on burnup, microstructure, and mechanical properties of pressurized water reactor fuels of, in-pile, (E)
ZIRCALOY-4—corrosion film formation on pressurized water reactor fuel element cladding of, (E)
—radiation effects on mechanical properties of, in-pile, (E)
—hydriding of reactor fuel rod cladding of, analysis of local, (E) (H.D.R.)

36034 FUEL ASSEMBLIES FOR NUCLEAR REACTORS. Bernander, Goeran; Dahlstrom, Jan (to Allmanna Svenska Elektriska Aktiebolaget). British Patent 1,192,229. 20 May 1970. Priority date 6 Oct 1966, Sweden.

REACTOR FUEL ELEMENTS—assemblies of water cooled and moderated rod type, description of varying spaced hexagon lattice
REACTORS, WATER-COOLED—fuel element assemblies for water moderated, description of varying spaced hexagon lattice
REACTORS, WATER-MODERATED—fuel element assemblies for water cooled, description of varying spaced hexagon lattice (D.C.C.)

36035 FEATURE ESTABLISHMENT OF FUEL CYCLE IN JAPAN: TECHNICAL AND ECONOMIC STUDY FUEL CYCLE AND FUEL FABRICATION FOR BWR. Okajima, Yasujiro (Japan Nuclear Fuel Co. Ltd., Yokosuka); Morita, Takahiro; Murota, Kazuo. Genshiryoku Kogyo; 16: 23-8(Jan 1970). (In Japanese).

Fuel production for BWRs is described on the following: the design of BWR fuel, the constitution of reactor core, fuel-assembly specification, design criteria and fuel characteristics; the production of fuel including fuel pellets, and quality control of fuel, and weight measurement and other controls; and the fuel control during reactor operation, including computer process control, power distribution control, and fuel-exchange program. (NSA of Japan)

36036 PRECISION OF NON-DESTRUCTIVE BURNUP MEASUREMENTS BY γ-SPECTROSCOPY ON FUEL RODS OF LIGHT-WATER REACTORS. Knoth, J.; Schwenke, H. (Institut fuer Reaktorphysik, Geesthacht, Ger.). Atomkernenergie; 15: 231-4 (1970).

Calculations have been made to determine the influence of burnup and cooling time as well as the properties of the measuring apparatus on the accuracy of nondestructive measurements by γ-spectroscopy. Results are given for fuel rods from boiling water reactors taking into consideration converted ^{239}Pu. Assuming a Ge(Li)-detector actually available, a measuring time lower than 10 min and a burnup of 15,000 MWd/t an accuracy of 6% after a cooling time of 1 week and 4% after a cooling time of 26 weeks has resulted. 2 references. (auth)

Auxiliary and Emergency Systems

36037 (AHSB(S)R-185) PERFORMANCE ASPECTS OF VENTILATED CONTAINMENT SYSTEMS FOR NUCLEAR REACTORS. Edwards, A. R. (United Kingdom Atomic Energy Authority, Risley (England). Authority Health and Safety Branch). May 1970. 19p. Dep. CFSTI (U. S. Sales Only).

The operation of a recirculation type of filtration-ventilation plant was studied, with particular attention to situations where the containment design state is not realized. It is concluded that the choice of the recirculation ratio used in the design has little effect on the system response to local deterioration, but influences the design point release. Small defects in the windward wall of the containment do not significantly increase the overall activity release unless the wind speed exceeds a critical value. The calculations show that holes up to .02 m^2/1 m^3/sec plant capacity may generally be regarded as small. (auth) (UK)

36038 (CONF-700608-11) EXPERIMENTAL STUDIES OF THE EFFECT OF FLOW RESTRICTIONS IN A SMALL ROD BUNDLE UNDER EMERGENCY CORE COOLANT INJECTION CONDITIONS. Davis, P. R. (Idaho Nuclear Corp., Idaho Falls). [1970]. 22p. Dep. CFSTI.

From American Nuclear Society Meeting, Los Angeles, Calif.

The effect of partial and total subchannel flow blockage on the capability of the emergency core coolant to remove heat from those portions of the fuel above the blocked area is studied. Test facilities are described. Test results are presented. (D.C.C.)

36039 NEW TECHNIQUE FOR BURST CARTRIDGE DETECTION. Hyun, Kyung Ho (English Electric Co. Ltd., Leicester, Eng.). J. Korean Nucl. Soc.; 1: 5-16(Sep 1969).

A design of new burst cartridge detection system for gas-cooled power reactor using a spherical sampling chamber with negative electrode is presented. The results of theoretical calculation indicate that the designed system is feasible for a practical application and sensitive enough to detect a 1 cm^2 hole in the fuel cladding. (auth)

36040 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. Cave, Leslie; Crickmer, John Richard (to Atomic Power Constructions Ltd.). British Patent 1,193,649. 3 Jun 1970. Filed 4 Oct 1966.

Reference is made to reactor emergency shutdown systems ("fuses") with particular reference to gas cooled reactors. The "fuse" system described comprises a hollow body having two compartments separated by a rupturable barrier. The first compartment contains a neutron poisoning material, and the arrangement is such that release of the poison into the second compartment reduces the multiplication factor in the region surrounding the "fuse" to below unity. The barrier is rupturable as a result of a temperature increase in the first compartment which raises the pressure differential across the barrier. The neutron poisoning material may be Cd and the barrier may be comprised of a β-containing material and secured by electron beam welding. Several barrier geometry arrangements are described. (UK)

Operation and Economics

36041 (HPR-117) HBWR QUARTERLY PROGRESS REPORT, OCTOBER-DECEMBER 1969. (Institutt for Atomenergi, Halden (Norway). OECD Halden Reaktor Prosjekt). Feb 1970. 100p. Dep. CFSTI (U. S. Sales Only).

HALDEN BOILING REACTOR—operations during October to December 1969
—control system for, development of digital computer
—fuel elements burnup in, measurement of test
—fuel elements for, post-irradiation examination of test
—instrumentation for, development of in-core

REACTOR CONTROL SYSTEMS—development of digital computer
REACTOR FUEL ELEMENTS—radiation testing of Zircaloy clad uranium oxide (UO_2) pin type (D.C.C.)

36042 FUEL CYCLE COST CALCULATION. Lee, Chang Kun; Kang, Jae Ho (AERI, Seoul). J. Korean Nucl. Soc.; 1: 55-65(Sep 1969).

Fuel cycle costs are tabulated for a 600 MW(e) power reactor operating in South Korea in 1974. The cost calculations are based on proposals submitted by Nuclear Power Group, Limited, General Electric, and Westinghouse. (H.D.R.)

Safety and Siting

Refer also to abstract 33861.

36043 (ANL-7609) LABORATORY SIMULATIONS OF CLADDING-STEAM REACTIONS FOLLOWING LOSS-OF-COOLANT ACCIDENTS IN WATER-COOLED POWER REACTORS. Hesson, James C.; Ivins, Richard O.; Wilson, Richard E.; Nishio, Kazuo; Barnes, Charles Jr. (Argonne National Lab., Ill.). Jan 1970. Contract W-31-109-eng-38. 39p. Dep. CFSTI.

Specimen Zircaloy-2-clad and Type 304 stainless steel-clad UO_2-pellet rods were electrically heated in steam and H_2–steam atmospheres to assess the damage that might be incurred in water-cooled reactor cores by a delay or failure in the operation of emergency core-cooling systems following loss of primary coolant. It was observed that when oxidized in a steam atmosphere, Type 304 cladding foams and expands at temperatures approaching its melting point (~1400°C). Zircaloy-2 cladding is severely embrittled when the total O_2 absorbed is about 18% or greater (as ZrO_2). Zircaloy-2-clad UO_2-pellet fuel rods can be heated to about 1200°C in a steam atmosphere and then water-quenched without incurring sufficient oxidation and embrittlement to break on cooling. At temperatures substantially above 1200°C, the cladding tends to crack and break on cooling. When exposed to pure H_2 for 6 min, or longer, at 1400°C, Zircaloy-2 cladding is embrittled due to hydriding. H_2 embrittlement is reduced by preoxidizing the cladding in steam, or by the presence of steam in the H_2. The effects of hydriding are adjudged secondary to those of steam oxidation, since conditions that might produce sufficient hydrogen embrittlement of the cladding in one core region would cause much greater embrittlement due to steam oxidation in other regions. 12 references. (auth)

36044 (BNWL-1315-2) NUCLEAR SAFETY QUARTERLY REPORT, FEBRUARY–APRIL 1970. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). May 1970. Contract AT-(45-1)-1830. 117p. Dep. CFSTI.

ACOUSTIC EMISSION TESTING—pipe failure detection by, development of system for
CALCINATION—radioactive waste fixation by pot and spray, (E)
CESIUM—removal by reactor containment air cleaning systems, (E/T)
CONTAINMENT SYSTEMS EXPERIMENT—air cleaning systems in, fission product removal by, (E/T)
—blowdown tests in, coolant void fraction in outlet pipe during, (E)
FISSION PRODUCTS—removal by reactor containment air cleaning systems, (E/T)
GAMMA RADIATION—dose to man from reactor accident generated airborne plume, computer code for thyroid and whole body
GLASS—production of phosphate, for fixation of radioactive wastes, (E)
HEATED EFFLUENTS—effects on cooling capacity of upper Mississippi River, (T)
IODINE—removal by reactor containment air cleaning systems, (E/T)
METHANE, IODO—removal by reactor containment air cleaning systems, (E/T)
MISSISSIPPI RIVER—cooling capacity of upper basin of, (T)
NEUTRONS, FAST—effects on fracture of heavy section pressure vessel steels, (E)
PIPES—crack detection in reactor pressure, acoustic emission method for
RADIOACTIVE WASTE—fixation by pot calcination, phosphate glass solidification, and spray solidification, (E)
—analysis for ruthenium-106, by γ scanning, (E)
REACTOR CONTAINMENT SYSTEMS—air cleaning systems in, fission product removal by, (E/T)
REACTOR SAFETY—engineered safeguards systems analysis for, (E/T)
—environmental consequences of accidents, computer code for potential radiological
REACTORS, WATER COOLED—coolant loss accidents in, void fraction in outlet pipe during blowdown, (E)
RUTHENIUM ISOTOPES Ru-106—determination in solidified radioactive wastes by γ scanning, (E)
STEEL—radiation effects on fracture of heavy section A533 plates, fast neutron, (E)
URANIUM—removal by reactor containment air cleaning systems, (E/T) (H.D.R.)

36045 (CONF-700608-8) EFFECTS OF CLAD SWELLING ON EMERGENCY CORE COOLING PERFORMANCE. Carbiener, Wayne A. (Battelle Memorial Inst., Columbus, Ohio). [1970]. Contract W-7405-eng-92. 10p. Dep. CFSTI.

From American Nuclear Society Meeting, Los Angeles, Calif.

The possibility of degraded ECCS performance due to Zircaloy cladding failures or swelling is analyzed. Scoping calculations are presented for blockage effects on ECCS performance and for critical blockage. The blockage effects under the local-radial power factors of 2.31 and 1.61 are studied through MUCHA-2 computer program calculations. 5 references. (D.C.C.)

36046 (CONF-700608-15) SIMULATION OF FUEL ROD BEHAVIOR IN A LIGHT WATER REACTOR LOSS-OF-COOLANT AND PRESSURE ACCIDENT (LOCA). Lawson, C. G. (Oak Ridge National Lab., Tenn.). [1968]. 18p. Dep. CFSTI.

From American Nuclear Society Meeting, Los Angeles, Calif.

Analysis of failure modes for Zircaloy-clad fuel elements under coolant loss accident conditions is presented. Data obtained on simulated fuel rods in a typical depressurization accident are included. Thermal and dimensional responses of the rods are analyzed. (D.C.C.)

36047 (IN-1319) NUCLEAR SAFETY PROGRAM DIVISION QUARTERLY TECHNICAL REPORT, JULY 1–SEPTEMBER 30, 1969. Dietz, K. A. (ed.) (Idaho Nuclear Corp., Idaho Falls). May 1970. Contract AT(10-1)-1230. 117p. Dep. CFSTI.

CAROLINAS-VIRGINIA TUBE REACTOR—containment structure for, performance under design basis accident conditions of, (E/T)
CONTAINMENT SYSTEMS EXPERIMENT—blowdown conditions for water cooled reactors in, comparison of RELAP3 computer program calculations with, (E/T)
REACTOR FUEL ELEMENTS—performance of uranium oxide (UO_2), effects of transient over-power conditions on, (E)
REACTOR SAFETY—coolant loss accidents in water cooled power reactors, critical flow condition during, (E/T)
—coolant loss accidents in water cooled power reactors, analysis of rod bundle critical heat flux during, (E/T)
—blowdown conditions in water cooled reactors, comparison of Containment Systems Experiment and RELAP3 computer program calculations for, (E/T)
—design basis accident conditions in water cooled reactors, performance of containment structure under, (E/T)
—transient over-power conditions for uranium oxide (UO_2) fueled water cooled reactors, (E)
REACTOR SAFETY EXPERIMENTS—fuel element performance in SPERT 4 CDC, effects of transient over-power conditions on uranium oxide (UO_2), (E)
REACTORS, POWER—coolant loss accidents in water cooled, critical flow condition during, (E/T)
—coolant loss accidents in water cooled, analysis of rod bundle critical heat flux during, (E/T)
REACTORS, WATER-COOLED—coolant loss accidents in power, critical flow condition during, (E/T)
—coolant loss accidents in power, analysis of rod bundle critical heat flux during, (E/T)
—blowdown conditions in, Containment Systems Experiment and RELAP3 computer program analysis of, (E/T) (D.C.C.)

36048 (IN-1354) SUBCOOLED-BLOWDOWN FORCES ON REACTOR-SYSTEM COMPONENTS: CALCULATIONAL METHOD AND EXPERIMENTAL CONFIRMATION. Hanson, George H. (Idaho Nuclear Corp., Idaho Falls). Jun 1970. Contract AT(10-1)-1230. 24p. Dep. CFSTI.

The loss-of-coolant accident (LOCA) can make structural demands on a nuclear power reactor system beyond normal requirements. Reliable predictions of the significant transient hydraulic loads are needed for the development of mechanical designs which will ensure coolability of the reactor core, even after such an accident. Dynamic hydraulic forces during blowdown are exerted on coolant loop components. These forces include: (a) the force which is due to fluid pressure that acts over the wetted surface and (b) the force which is due to friction between the wetted surfaces and the fluid. The dynamic forces can be calculated by performing two spatial integrations; however, their evaluation may be difficult. The two spatial integrals are two terms in the conservation-

of-momentum equation. With one-dimensional subcooled-blowdown digital computer programs such as BURST (Blowdown Under a Rapid Sonic Transient) and WHAM (Water HAMmer), the calculation of the transient hydraulic force on a coolant loop component during blowdown is accomplished more easily and through only one spatial integration by evaluating the remaining terms in the momentum equation. The calculation method was confirmed by experimental blowdown studies, which were carried out using two experimental facilities, the semiscale vessel and the pipe blowdown apparatus. The information obtained using this calculational method is sufficiently reliable for use as forcing-function input for structural dynamics codes to establish the response of the components in a power reactor system to a loss-of-coolant accident. (auth)

36049 (IN-1362) STRAP: COMPUTER CODE FOR STATIC AND DYNAMICS STRUCTURAL ANALYSIS AND STUDIES MADE USING THE CODE. Dearien, J. A.; Noble, C.; Uldrich, E. D. (Idaho Nuclear Corp., Idaho Falls). Jun 1970. Contract AT(10-1)-1230. 43p. Dep. CFSTI.

The computer code STRAP (STRuctural Analysis Package), developed to perform static and dynamic analyses of reactor structural systems, is described. The code uses the finite element method to model a structure and an uncoupled modal summing procedure to perform the dynamic analysis. STRAP is a three-dimensional structural analysis code and can be used in the static and dynamic analyses of structures having up to 250 degrees of freedom. Studies on structural modeling techniques were made using the code, and guidelines are given for the modeling process. 9 references. (auth)

36050 (IN-1380) FISSION PRODUCT BEHAVIOR ANALYTICAL DEVELOPMENT PROGRAM. Technical Description. (Idaho Nuclear Corp., Idaho Falls). Jun 1970. Contract AT-(10-1)-1230. 28p. Dep. CFSTI.

Analytical models for predicting the behavior of fission products in a loss-of-coolant accident for a water-moderated nuclear power reactor are described. Model development is proposed for specific steps in the transport of fission products from the fuel to the reactor containment building. These areas of fission product behavior are: release from the fuel to the fuel-cladding gap, venting of the fuel-cladding gap upon cladding rupture, transport through the reactor vessel, and behavior within the containment building. A summary of related analytical programs on fission product behavior and a summary of the models existing for each of the steps for which development is planned are included. 44 references. (auth)

36051 (ORNL-TM-2984) ORNL NUCLEAR SAFETY RESEARCH AND DEVELOPMENT PROGRAM BIMONTHLY REPORT FOR MARCH-APRIL 1970. Cottrell, Wm. B. (Oak Ridge National Lab., Tenn.). Jun 1970. Contract W-7405-eng-26. 178p. Dep. CFSTI.

The accomplishments during the months of March and April in the research and development program under way at ORNL as part of the U. S. Atomic Energy Commission's Nuclear Safety Program are summarized. Much of the work is in general support of water-cooled power reactor technology, including LOFT and industry programs, and reflects current safety problems, such as measurements of prompt fuel element failure phenomena and the efficacy of containment-spray and pool-suppression systems for fission-product removal. Also included are studies on the release and behavior of accident released fission products, as well as the removal of these fission products and aerosols from gas streams by filters and adsorbers. Several projects are also conducted in support of the high-temperature gas-cooled reactor (HTGR) and liquid-metal fast breeder reactor (LMFBR) programs. Other major projects include studies of primary piping and steel pressure-vessel technology. Experimental work relative to pressure-vessel technology includes investigations of the attachment of nozzles to shells and the implementation of joint AEC-PVRC programs on heavy-section steel technology and nuclear piping, pumps, and valves. Several of the projects are directly related to the AEC's standards program, which entails development of engineering safeguards and the establishment of codes and standards for government-owned or -sponsored reactor facilities. The recent activities of NSIC and the Nuclear Safety journal in behalf of the nuclear community are also discussed. Of particular interest in both of these activities is the recent emphasis on environmental effects. (auth)

36052 INCIDENTS OF PRESSURIZED WATER REACTORS, PART II. TESTS WITH GLASS CONTAINERS FOR HIGH PRESSURE AND STEEL CONTAINER TESTS. Leistner, G.; Ruediger, B.; Zimmermann, M. (Battelle-Institut, Frankfurt am Main). Atomwirt., Atomtech.; 15: 235-8(May 1970). (In German).

In model experiments, rupture of the primary steam circuit of a boiling water reactor is studied by means of glass and steel containers. The steel container possesses a glass window through which pictures can be taken with a movie camera. Pressure in the glass container amounts to 45 atm and in the steel container 70 atm. Rupture of the primary steam circuit is simulated by shooting a bullet through a containing plate. Pressure, temperature, mechanical forces, and rate of steam loss are measured and filmed. (H.B.G.)

36053 A SIMPLE COOLANT BLOWDOWN MODEL FOR THE EVALUATION OF SAFETY PROBLEMS IN WATER-COOLED REACTORS WITH PRESSURE VESSELS. Mesarovic, M. M. (Nuclear Power Plant Dept., Belgrade). Nucl. Eng. Design; 12: 215-30(1970).

A simple coolant blowdown model applicable to water-cooled pressure vessel reactors was developed. It is used to predict the reactor pressure-temperature transients during postulated loss of coolent, loss of heat sink, pump failure and similar accidents, with the aid of a small capacity digital computer. A three-zone one-dimensional presentation of reactor and pressure vessel is adopted. The physical conservation laws are solved for the reference BHWR, BWR and PWR designs by introducing a number of pessimistic system assumptions. The rates of heat generation, feed water inflow and enthalpy and several other quantities were allowed to vary. Moody's model was used to calculate the discharge rate of coolant from the pressure vessel after a rupture. The model is then applied both to a direct cycle BHWR and to an indirect cycle BHWR with integrated steam generators. Numerical solutions to specific postulated situations are presented. The influence of major assumptions and principal input parameters were investigated. (auth)

36054 THEORY OF SIMILARITY OF THE DEPARTURE FROM NUCLEATE BOILING IN FORCED CONVECTION FLOW. Kampfenkel, O. (Siemens AG, Erlangen, Ger.). Atomkernenergie; 15: 205-10(1970).

A theory of similarity is set up to calculate the critical heat flux in wide ranges of parameters and to examine the validity of FREON-tests simulating water conditions. The characteristic numbers, which describe the burnout phenomenon in forced convection flow, are derived from dimensional analysis. The use of the local conditions hypothesis gave realistic results for this investigation. The mathematical connection of the main nondimensional groups is established by evaluating burnout water data. The correlation can also be applied to FREON. From this correlation a graphical method to determine the critical heat flux is stated. 7 references. (auth)

Power Conversion Systems

36055 (EIR-181) GAS TURBINE POWER CONVERSION SYSTEMS FOR HELIUM COOLED BREEDER REACTORS. Lys, L. A.; Ciszewski, G.; Frutschi, H. (Eidgenoessisches Institut fuer Reaktorforschung, Wuerenlingen (Switzerland)). Apr 1970. 21p. (CONF-700401-4). Dep. CFSTI (U. S. Sales Only).

From Gas-Cooled Reactor Program Information Meeting, Oak Ridge, Tenn.

From the point of view of fuel cycle cost, helium cooled fast reactors do not require high efficiencies. Thus, the attractiveness of using gas turbines, even at the moderate gas temperatures typical of this reactor type, rests on the ability to achieve a reduction of the capital investment which is sufficient to produce lower power generation cost. Two main types of systems are possible: a direct helium turbine system and an indirect system using CO_2 turbines. The two systems are described. Problems related to the turbomachinery design and to plant control are discussed. (auth)

36056 NUCLEAR POWER STATIONS. (to Sulzer Brothers Ltd.). British Patent 1,193,609. 3 Jun 1970. Priority date 17 May 1968, Switzerland.

REACTORS, GAS-COOLED—power conversion system for power, description of closed cycle
REACTORS, POWER—power conversion system for gas cooled, description of closed cycle (D.C.C.)

36057 REACTOR CORE FOR FAST REACTORS FOR THE DIRECT CONVERSION OF THE HEAT SET FREE INTO ELECTRICAL ENERGY. (to Brown, Boveri and Cie, Aktiengesellschaft). British Patent 1,193,541. 3 Jun 1970. Priority date 3 Jan 1967, Germany.

REACTORS, FAST—core for thermionic, description of spaced cylinder shaped discs
REACTORS, POWER—core for fast thermionic, description of spaced cylinder shaped discs (D.C.C.)

36058 IMPROVEMENTS IN OR RELATING TO HEAT EXCHANGERS. Taylor, Peter Anthony (to Babcock and Wilcox Ltd.). British Patent 1,194,680. 10 Jun 1970. Filed 16 Sep 1966.

Reference is made to heat exchangers in which liquid sodium is employed such as may be used in nuclear reactor plants. In conventional heat exchangers of this type "dry out" may occur, with consequent deterioration of the metal tubes. In the heat exchanger described two flow paths are provided, one of which is connected to the source of liquid sodium and the other to the source of fluid to be heated (normally water). The former flow path includes two parts in heat exchange relationship, the first lying upstream of the second part and encircling the second part, and comprising an annular passage extending along the length of the heat exchanger, whilst the second flow path extends with the second part but not the first part. The two parts may be separated by a partition extending along the length of the heat exchanger, presenting a curved surface to the first part and a concave surface to the second part, the flow of sodium being along the length of the first part. The first part may be formed by the annular space between two co-axial tubular walls and the second part may be within the inner tubular wall. The second part may also be divided into two longitudinally extending portions in side-by-side relationship by a laterally extending baffle; the sodium then flows in opposite directions in the two portions. The flow path for the fluid to be heated may include a number of U-tubes, one limb of each U-tube lying in one of the longitudinally extending portions and the other limb in the other longitudinally extending portion. The second part of the flow path, may be constituted by the annular space between the inner tubular wall and an annular baffle coaxial with the inner tubular wall. One limb of each U-tube may lie in the annular space and the other limb within the annular baffle. (UK)

36059 NEW CONCEPT FOR LIQUID METAL-STEAM GENERATORS UTILIZING THERMAL CONVECTION TUBES. France, D. M.; Petrick, M. (Argonne National Lab., Ill.). Nucl. Eng. Design; 12: 269-76(1970).

A new concept for a liquid metal heated steam generator for use with liquid metal fast breeder reactors is presented. The new system eliminates several of the more serious problems associated with single pass shell and tube heat exchangers which have been proposed for this application. Separation of boiler and superheat stages is accomplished in the new system as well as increased protection against sodium-water reactions and the elimination of an intermediate, sodium-sodium, heat exchanger. The steam generator employs natural circulation boiling tubes (thermal convection tubes) as a means of transferring heat from primary sodium to water. A method of analysis of these tubes is presented, and the results as applied to a 3000 MW steam generation system are given. 11 references. (auth)

Research and Test Reactors

Refer also to abstracts 34345, 34838, 34924, and 36047.

36060 (BAW-3647-17) PHYSICS VERIFICATION PROGRAM, PART III, TASK 4; Quarterly Technical Report, January-March 1970. Baldwin, M. N.; Stern, M. E. (Babcock and Wilcox Co., Lynchburg, Va. Research and Development Div.). Jun 1970. Contract AT(30-1)-3647. 13p. Dep. CFSTI.

Results of a series of experiments to measure the effects of lattice heterogeneities are presented. The water moderated critical assembly, fuel rods, and poison rods are described. Unclad Pyrex glass rods, aluminum-clad Vicor glass rods, aluminum-clad Al_2O_3 rods, and water holes were spaced on selected patterns in an otherwise uniform clean lattice and their effects on reactivity and power shape were determined. (H.D.R.)

36061 (BNWL-1387) EXPERIENCE WITH CONTROL ROD SEALS USED ON SODIUM-COOLED REACTORS. Gordon, N. R. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Jun 1970. Contract AT(45-1)-1830. 236p. Dep. CFSTI.

A survey was made to determine the state-of-the-technology on elastomeric reactor seals to provide a better background for design of FFTF seals. The survey revealed only two applications of elastomeric seals within a reactor. Information on silicone rubber and ethylene propylene rubber indicate that they should be considered for some of the penetration seals on the FFTF. 295 references. (auth)

36062 (DOCKET-50184-20) NATIONAL BUREAU OF STANDARDS REACTOR. Facility License No. TR-5. (Division of Reactor Licensing (AEC), Washington, D. C.). 30 Jun 1970. 20p. Dep. CFSTI.

36063 (DOCKET-50184-21) NATIONAL BUREAU OF STANDARDS REACTOR. Operations Report No. 8, January-March 1970. (National Bureau of Standards, Washington, D. C.). 16 Jun 1970. 13p. Dep. CFSTI.

36064 (GA-10146) FAST REACTOR SPECTRUM MEASUREMENTS. Quarterly Progress Report for the Period Ending April 30, 1970. Young, J. C.; d'Oultremont, P.; Neill, J. M.; Borgonovi, G. M.; Houston, D. H. (Gulf General Atomic, Inc., San Diego, Calif.). 15 May 1970. Contract AT(04-3)-167. 37p. Dep. CFSTI.

EXPONENTIAL PILES—neutron spectra in STSF-1A in keV energy range, time-of-flight and proton recoil analysis of, (E/T)
—neutron spectra in STSF-1A, effects of detector efficiency on time-of-flight, (E/T)
NEUTRONS, FAST—spectra in STSF-1A, time-of-flight and proton recoil analysis of, (E/T)
—spectra in STSF-1A, effects of detector efficiency on time-of-flight, (E/T)
RADIATION DETECTORS, SCINTILLATION—efficiency of lithium-glass and NE-213, effects on neutron time-of-flight spectra of, (E/T) (H.D.R.)

36065 (IN-1370) SPERT PROJECT. Annual Report, October 1968-September 1969. Taxelius, T. G. (Idaho Nuclear Corp., Idaho Falls). Jun 1970. Contract AT(10-1)-1230. 211p. Dep. CFSTI.

HYDROGEN—production from uranium oxide (UO_2) reactions with water, (E)
LIQUID METAL FAST BREEDER REACTOR—fuel elements of, failure testing of Type 304 stainless steel clad, (E)
NEUTRONS, THERMAL—flux distribution in pulsed SPERT, (E/T)
PRESSURE VESSELS—failure of water cooled reactor, reactivity accident requirements for, (E)
PLUTONIUM OXIDES (PuO_2)—PuO_2-UO_2, failure testing of irradiated stainless steel clad and unirradiated Zircaloy-2 clad
REACTOR FUEL ELEMENTS—failure testing of irradiated stainless steel clad and unirradiated Zircaloy-2 clad uranium oxide (UO_2) and plutonium oxide (PuO_2)-uranium oxide (UO_2), (E)
—failure of water cooled uranium oxide (UO_2), hydrogen production from, (E)
REACTOR SAFETY EXPERIMENTS—fuel elements of SPERT 4 CDC, failure testing of LMFBR Type 304 stainless steel clad, (E)
—fuel elements of SPERT 4 CDC, failure testing of irradiated stainless steel clad and unirradiated Zircaloy-2 clad uranium oxide (UO_2) and plutonium oxide (PuO_2)-uranium oxide (UO_2), (E)
—physics measurements in pulsed SPERT, simulation of large core dynamics by, (E/T)
REACTORS, WATER-COOLED—pressure vessels for, reactivity accident requirements for rupture of, (E)
STAINLESS STEEL—failure testing of fuel element cladding of Type 304
URANIUM OXIDES (UO_2)—failure testing of irradiated stainless steel clad and unirradiated Zircaloy-2 clad
—reactions with water, hydrogen production from, (E)
—PuO_2-UO_2, failure testing of irradiated stainless steel clad and unirradiated Zircaloy-2 clad
WATER—reactions with uranium oxide (UO_2), hydrogen production from, (E)
ZIRCALOY 2—failure testing of fuel element cladding of (D.C.C.)

36066 (KFK-1143) SAFETY REPORT FOR FR-2 INSERTED CAPSULE EXPERIMENTS WITH SEVERAL NaK CAPSULES FOR IRRADIATION OF HIGH-CONDUCTIVITY FUEL ELEMENTS. Haefner, H. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorentwicklung). Jan 1970. 62p. (In German). Dep. CFSTI (U. S. Sales Only).

Irradiation of U/Pu mixed carbide fuel pins of lengths up to 1 m is scheduled to start in the FR2 reactor in early 1970 as part of the irradiation program to be performed within the framework of the Fast Breeder Project. At the initial stage, comprising experimental group No. 6, pins of 475 mm length (300 mm fuel length and 10 mm outer diameter of the cladding tube) will be introduced including pins with He and Ar bonding as well as with Na bonding. The central fuel temperature (2,000°C max.) will be measured in the case of fuel pins with gas bonding. Maximum pin power is intended to be 1,150 W/cm for a temperature of the cladding tube surface of 630°C; for the time being, the burnup is limited to 50,000 MWd/te of fuel. For the purposes of this irradiation ex-

periment a capsule for a high pin power was developed using NaK as heat transfer medium which surrounds the fuel pin. The separation between NaK and the reactor cooling water is achieved by only one wall which consists of a capsule tube of niobium-1% zirconium. An intermediate tube with good thermal conductivity is fitted into the NaK gap in order to achieve lower heat flux densities on the capsule surfaces and to avoid convection in the NaK. In addition to the description of the capsule rigs and their operational behavior, the actual safety considerations which play a particularly important part because of the possible risks of NaK/water reactions resulting from a leak in the capsule are also discussed. (29 references) (auth)

36067 (ORNL-TM-2931) HIGH-SPEED SCAN PROGRAMS FOR THE HFIR DIGITAL CONTROL AND DATA ACQUISITION SYSTEM. Danforth, H. P. (Oak Ridge National Lab., Tenn.). 20 Apr 1970. 31p. Dep. CFSTI.

Four computer programs were developed to allow simple operator control of high-speed scanning of particular reactor variables for subsequent reactor diagnosis studies. An explanation of the program and hardware operations for interpreting operator console switches, setting up analysis parameters, establishing scanning frequency, storing the data on the drum memory, and initiating the power spectral density analysis of a fluctuating signal is presented. (auth)

36068 (ORNL-TM-3043) BULK SHIELDING FACILITY QUARTERLY REPORT, JANUARY-MARCH, 1970. Tabor, W. H.; Hurt III, S. S.; Nixon, T. B. (Oak Ridge National Lab., Tenn.). 26 May 1970. Contract W-7405-eng-26. 53p. Dep. CFSTI.

The BSR operated at an average power level of 1946 kW for 51.7% of the time during January, February, and March of 1970. Water-quality control in both the reactor primary and secondary cooling systems was very satisfactory. There were seven unscheduled shutdowns, six of which were caused by shim rods dropping and one by the failure of the log-N amplifier. Of the six unscheduled shutdowns caused by the dropping of shim rods, one was caused by the No. 1 shim rod, two by the No. 4 shim rod, and three by the No. 2 shim rod. The PCA was operated for one day during this quarter. The facility was used as a training aid for students from the University of Kentucky. (auth)

36069 FATIGUE STRENGTH OF THE IN-PILE TUBE OF OWL-1 IN JMTR. Fujimura, Tadato (Japan Atomic Energy Research Inst., Tokai); Shibata, Katsuyuki; Nomura, Sueo; Ando, Yoshio; Iida, Kunihiro. Yosetsu Gakkaishi; 39: 253-8(Apr 1970). (In Japanese).

The first in-pile loop of the JMTR is the OWL-1. Stainless steel SUS 43 (AISI 347) is used as the material of the in-pile tube: the tube is 5 meters long, 60.2 mm in outside diameter, with wall thickness 5.2 mm. Welded joints are necessary to fabricate the loop. Since the welded joints are within the reactor, sufficient strength and rigorous accuracy are required for the joints. Electron-beam welding was first considered where the safety must be assured. The results of tests on electron-beam welded-joint specimens and joint-less specimens, including the tensile test, cyclic-pressure test, micro-tensile test and bending fatigue test are presented. The strengths of the different specimens are compared, followed by some discussions. Conclusions are presented. (auth) (NSA of Japan)

36070 A MULTIGROUP TWO-POINT KINETIC MODEL FOR THE TIME-DEPENDENT ANALYSIS OF TWO-ZONE FAST NEUTRON SYSTEMS. d'Oultremont, P.; Young, J. C. (Gulf General Atomic Inc., San Diego, Calif.). Contract AT(04-3)-167 PA 35. Nucl. Sci. Eng.; 40: 338-42(May 1970).

The prompt-neutron kinetics of two-zone fast subcritical systems is investigated by the development of a two-point multigroup kinetic model based on the collision frequency method used in the zero-dimensional diffusion code CAGE 2. The reactor is spherical and the external zone may be a reflector or may contain fissile material. The time-dependent behavior of the neutron population is calculated independently in each zone, the other zone being considered as a time-dependent source. Calculated and measured data for the STSF-2 system are compared. 10 references. (H.D.R.)

36071 THE ASSESSMENT OF THE MULTIPLICATION CONSTANT, INFINITE, OF A REACTOR FUEL SAMPLE. (SNAM Progetti S.p.A.). British Patent 1,196,333. 24 Jun 1970. Priority date 14 Jul 1966, Italy.

REACTOR FUELS—multiplication constant for, experimental technique for measurement of infinite (D.C.C.)

36072 IN-CORE HEAT TRANSFER IN MTR PLATE TYPE FUEL ELEMENTS. Kreyger, P. J.; Essler, W. A.; Dellmann, W. (Commission of the European Communities, Petten, Netherlands). Nucl. Eng. Design; 12: 231-48(1970).

Thermal and hydraulic measurements were performed in the core of the High Flux Reactor at Petten. Pertinent design details of the special fuel elements are described together with the experimental procedure. The results with steady forced and natural convection and on sudden loss of forced coolant flow are presented and compared with calculated values. (auth)

Process Heat and Desalination Reactors

36073 TECHNICAL PROCESS ANALYSIS OF RAW COAL GASIFICATION WITH NUCLEAR HEAT. Femmer, U.; Franke, F. H.; Meraikib, M. (Technische Hochschule, Aachen). Atomwirt., Atomtech.; 15: 240-2(May 1970). (In German).

A promising utilization of process heat from nuclear reactors is the endothermic production of gas for reduction processes, for synthesis, and for burning. System analysis shows that soft coal could be utilized economically in large high temperature reactors. Theoretical considerations show that for iron ore reduction, the gas should have a temperature of 1000°C and high pressure. Cost analysis leads to the conclusion that the high temperature reactor should have a power of approximately 3000 MW(t). Preliminary experiments reveal that natural water content of soft coal, about 43% is sufficient for production of an ideal gas mixture. (H.B.G.)

Marine and Portable Power Reactors

36074 (DOCKET-50238-61) N. S. SAVANNAH. Failed Bronze Valve Stem Replaced with Monel. (First Atomic Ship Transport, Inc., New York). 19 Jun 1970. 2p. Dep. CFSTI.

36075 (DOCKET-50238-62) N. S. SAVANNAH. Operations Report, November 3, 1969-April 25, 1970. (First Atomic Ship Transport, Inc., New York). Jun 1970. 18p. (FAST-19). Dep. CFSTI.

36076 NUCLEAR PROPULSION FOR CONTAINER SHIPS. Gaunt, I. A. B.; Rouse, J. R.; Wilkinson, G. R. (Vickers Ltd., Barrow-in-Furness, Eng.). Nucl. Energy; 11: 86-91(May-Jun 1970).

Several studies have been made of nuclear powered ships which include tankers, a cargo liner, a passenger liner, container ships, and a very large oil tanker. The studies associated with medium sized tankers, a cargo liner, and a passenger ship, while providing very valuable data, indicated that, on economic grounds, there was no justification for their further development. Considerable aids in achieving optimal reactor designs had been provided by the United Kingdom Atomic Energy Authority. A PWR (pressurized water reactor) designed by the UKAEA had been chosen. The team concluded that the case for nuclear powered container ships was strictly in terms of their economic viability. In these terms, the team has evolved a "global fleet" concept as an improvement on the previously argued merits of a nuclear powered vessel. (auth) (UK)

Reactor Theory

36077 MNOGOGRUPPOVYE METODY RASCHETA ZASHCHITY OT NEITRONOV. (Multigroup Calculation Methods for Neutron Shielding). Bergel'son, B. R.; Suvorov, A. P.; Torlin, B. Z. Moscow; Atomizdat (1970). 272p.

The principal problems relating to the use of multigroup approximations for calculating neutron shielding for nuclear reactors are described. The kinetic equations for neutron transport, group constants, method of spherical harmonics, and other methods for solving kinetic equations including the method of moments, double P_n-method, discrete ordinates, and asymptotic solutions are discussed. A method of integral equations and use of integral equations for the case of isotropic indices of neutron scattering, and for calculating spectra of fast neutrons in the shielding is described. Semiempiric methods, multi-group approximations, hydrogen free shielding, and various modifications of the semiempiric methods are also analyzed. (R.V.J.)

36078 TRENDS IN REACTOR PHYSICS. Yiftah, Shimon (Israel Atomic Energy Commission, Yavne). Nippon Genshiryoku Gakkaishi; 11: 735-7(Dec 1969). (In Japanese).

The present state of the research in the peaceful use of atomic energy in Israel is reviewed. The construction of reactors for the dual purposes of electric power generation and desalting is being examined in Israel. The general trend in reactor physics is discussed. Developments in basic nuclear physics, the statistical dynamics of particles, computer and computer codes, and integral experiments to check calculations are described. Active research is now concentrated on fast reactors, the efficient evaluation of nuclear data, the detailed study of reactor dynamics, and the detailed calculation of Doppler or Na-void effect. (NSA of Japan)

Kinetics

Refer also to abstract 36002.

36079 (GA-10103) GAPER-2D: A TWO DIMENSIONAL TRANSORT PERTURBATION THEORY PROGRAM. Archibald, R. J.; Sargis, D. A. (Gulf General Atomic, Inc., San Diego, Calif.). 29 Apr 1970. Contract AT(04-3)-167. 61p. Dep. CFSTI.

A two-dimensional first order transport perturbation theory program, GAPER-2D, was written to evaluate reactivity coefficients in reactor assemblies. Scalar neutron fluxes and currents, as computed by a two-dimensional discrete ordinates code in r-z or x-y geometry, are utilized with leakage and anisotropic scattering effects treated in a P_1 approximation. The program computes contributions to the change in inverse multiplication factor $\Delta(1/k)$ due to perturbations in the individual capture, net fission, total scattering, (n,2n), inelastic scattering, and leakage cross sections. The individual contributions are computed and displayed for each energy group and for each perturbed region within the assembly. Numerical calculations have been in good agreement with direct transport results and the perturbation theory calculations require far less computer execution time than the corresponding discrete ordinates computations. 4 references. (auth)

36080 (RT/FI-(69)46) STATIONARY NEUTRON TRANSPORT IN PLANE HETEROGENEOUS ASSEMBLIES. Trombetti, T. (Comitato Nazionale per l'Energia Nucleare, Bologna (Italy). Centro di Calcolo). [1969]. 23p. Dep. CFSTI (U. S. Sales Only).

New methods for the solution of the neutron transport equation have been recently proposed and utilized. Multigroup energy dependence, anisotropic scattering and heterogeneity effects are incorporated together into a general formulation, with the aim of increasing the practical value of the methods as far as reactor calculations are concerned. 14 references. (auth)

36081 (RT/FIMA-(69)6) DIGITIZING PLANAR REGIONS FOR MONTE CARLO TRANSPORT PROBLEMS. De Matteis, A. (Comitato Nazionale per l'Energia Nucleare, Bologna (Italy). Centro di Calcolo). [1969]. 12p. Dep. CFSTI (U. S. Sales Only).

By digitizing planar regions, the geometrical part in the tracing of particle life histories in Monte Carlo transport problems becomes very simple. Algorithms are described for the simulation of particle free-flights and some results are presented. (auth)

36082 OPTIMAL CONTROL OF A NUCLEAR REACTOR SYSTEM WITH DISTRIBUTED PARAMETERS. I. Kuroda, Yoshiteru; Makino, Akila (Tokai Univ., Tokyo). Tokai Daigaku Kiyo Kogakubu; 1969: No. 1, 13-17(Mar 1970). (In Japanese).

An approach to the optimal control of a distributed-parameter nuclear reactor system is presented. The mathematical model involved is given by a linearized, one-group diffusion equation with one-group delayed neutron. Control strategy is to perform terminal control on the neutron flux distribution in the nuclear reactor model, under the condition of minimizing the energy required for control action. Optimization is based on Wang's technique using the principle of optimality in dynamical programming. As a necessary condition for the optimal solution a set of simultaneous integral equations is obtained which agrees essentially with that derived by Kyong. (NSA of Japan)

36083 EFFECT OF ADDED SCATTERERS ON NUCLEAR CRITICALITY. Iwai, Makoto (Power Reactor and Nuclear Fuel Development Corp., Tokyo). J. Nucl. Sci. Technol. (Tokyo); 7: 291-9(Jun 1970).

Experience involving basic concept of nuclear criticality has shown that there are many complex effects involved, some of which have been little studied and are not well understood. One of these involves the effect of added scatterers on criticality. A study has been made of the effect of added scatterers (O, C, N) on criticality by means of transport theory calculations utilizing the DTF codes. This study pertains to Pu compounds likely to be encountered throughout the nuclear industry, as in fuel processing and fabrication operations. It is shown that in some cases of undermoderated thin slab with hydrogenous reflectors, the effect of added scatterers can cause an increase in the critical dimension contrary to the usual expectation that the size should be reduced in such cases. Interpretation of the results obtained for water-reflected and Ni-reflected slabs, including scatterers added homogeneously to the core region, contribute to a better understanding of the observed effects. The dominant factor causing the increase in slab thickness is the decrease of neutron leakage into the moderating reflector. (16 references) (auth)

36084 SOLUTION OF MULTIGROUP NEUTRON FLUX LINEAR EQUATIONS. Pollard, J. P. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Aust. Comput. J.; 2: 50-4(May 1970).

The Sokolov method of averaging functional corrections is adapted to solution of the multigroup neutron flux equation for an infinite homogeneous reactor system. Convergence of the usual iterative methods is improved using direct solution of an associated approximation for the neutron flux. Calculations undertaken show the method to be quicker than either the Gauss-Seidel iterative method or the Gauss-Jordan direct method. (auth) (Australia)

36085 METHOD OF SOLVING NONSTATIONARY KINETIC EQUATIONS ALLOWING FOR DEPLETION. Voronkov, A. V.; Chuyanov, V. A. This paper was summarized in At. Energ. (USSR); 27: 140(Aug 1969) as paper No. 326/4441. (In Russian).

36086 FIRST-FLIGHT COLLISION PROBABILITIES FOR COATED FUEL PARTICLES IN CYLINDRICAL OR ANNULAR ZONES. Schriewer, Johannes (Gutehoffnungshuette Sterkrade AG, Oberhausen, Ger.). Atomkernenergie; 15: 199-204(1970).

The calculation of resonance integrals by means of Nordheim's integral method requires the knowledge of first-flight collision probabilities in the fuel lump. To compute these quantities a numerical procedure has been developed, based on homogenized fuel in cylinders or annuli, and extended to coated particles mixtures. By comparison of numerical results obtained for homogeneous as well as heterogeneous fuel the accuracy of the method is shown. For either case ^{240}Pu resonance integral calculations were performed to demonstrate the influence of the grain structure. 10 references. (auth)

36087 MONTE CARLO METHOD FOR CALCULATION OF ALBEDO BOUNDARY CONDITIONS AT THE SURFACE OF A CYLINDRICAL BLOCK. Barkov, S. N. This paper was summarized in At. Energ. (USSR); 27: 335-6(Oct 1969) as paper No. 347/5338. (In Russian).

When making heterogeneous calculations for reactors it is usually assumed that the diffusion approximation is valid in the regions between the breeding and absorbing blocks. The blocks are taken into account by using effective boundary conditions. The diffusion approximation is used in order to determine the structure of the multigroup albedo boundary conditions. A Monte Carlo method is used to calculate the albedo matrices which characterize the block for each harmonic of the Fourier expansion of the neutron current at the block surface. This method for calculating albedo matrices can also be used for higher harmonics. A more precise angular distribution of neutrons incident on the block can be obtained after the introduction of a buffer zone of moderating material around the block. (auth)

36088 USE OF MATHEMATICAL FORMALISM FOR DETERMINING THE NEUTRON SPECTRUM OF A REACTOR WITH RESPECT TO THE DETECTOR ACTIVITY. Zinov'ev, N. V. This paper was summarized in At. Energ. (USSR); 26: 58-9 (Jan 1969) as paper No. 259. (In Russian).

From the mathematical point of view, the problem of determining the neutron spectrum $\Phi(E)$ with respect to the activity A_i of threshold resonance, or other types of detectors is indeterminate, since there is an infinite number of solutions satisfying the system of equations. The problem becomes sufficiently determinate only if physical considerations reduce the class of possible solutions to a minimum. Unfortunately, the reactor theory, the number of available detectors, and the accuracy in measuring the reaction cross sections $\sigma_i(E)$ and the activities A_i cannot ensure an adequate correspondence between the possibilities of experimental investigation and the requirements of elementary statistics. Considering the results previously published, it is concluded that the determination of $\Phi(E)$ must be based on the strategy of the minimum-maximum of the risk function. In this case, the risk function R can be reduced to the form $R(j) = c_j\chi_j^2$ $(j = 1, 2, \ldots m)$, where c_j is the probability that the j-th assumption $\Phi_j(E)$ concerning the form of the $\Phi(E)$ function will be correct, and χ_j^2 is the Pearson

χ-square test for the scattering of theoretical and experimental A_i values for the j-th solution. The unknown $\Phi_j(E)$ parameters are determined on the basis of the usual formalism of the method of least squares. For a sufficient diversified choice of $\Phi_j(E)$ functions from a class of physically valid functions, the amplitudes and signs of systematic errors will have a random distribution for different solutions, so that the total systematic error will tend to zero with an increase in m. (auth)

Experimental Applications

36089 PULSED NEUTRON METHOD APPLIED TO THE INTERACTION BETWEEN MODERATORS. Grosshoeg, G. (Chalmers Univ. of Tech., Goteburg). J. Nucl. Energy; 24: 101-9(Apr 1970).

The possibility of using the pulsed neutron method to study two interacting moderators was investigated. The decay constants were measured in a system consisting of two polyethylene discs separated along the symmetry axis. The experiments covered a range in decay constants from 10,000 to 40,000 s^{-1}. It was found that in all the experiments, with the exception of those in the limits zero and infinite separation distance, the decay constants were drifting in time. Therefore they could not, within the scope of these experiments, be looked upon as discrete modes or reliable pseudomodes. This behavior was confirmed by a qualitative theoretical investigation. The result can be extended to include all experiments with the pulsed neutron method applied to moderators containing cavities or having concave boundaries. A method to eliminate the drifting effect through the incorporation of absorbers in the cavities is suggested. (auth) (UK)

36090 COLLISION PROBABILITY CRITICALITY CALCULATIONS. Hunt, D. C. (Dow Chemical Co., Golden, Colo.). J. Franklin Inst.; 289: 175-84(Mar 1970).

A method is presented for computing the multiplication factor of single region systems which contain fissile material and which may be specified by one, two or three coordinates. The systems are assumed to be unreflected, homogeneous assemblies which have no re-entrant surfaces. The method follows the successive scattered neutron collisions which take place in a system and computes for each interaction the product of the probability of a fission collision and the average number of secondaries per fission. The sum of these products, in the limit as the number of collisions become infinite, is the multiplication factor of the system. The initial energy distribution of the neutron-source density needed to start the calculations is specified in a sixteen energy-group format. The initial spatial neutron distribution is assumed to be uniform and to remain unchanged as a result of collisions. The source-density amplitudes for each successive collision are taken as the probability of a scattering interaction multiplied by the source-density amplitude for the previous collision. The source-density energy distribution is recomputed after each collision using multigroup methods. Critical sizes are found by obtaining the multiplication factor as a function of the system dimensions and graphically determining the dimensions which make the factor equal unity. The critical dimensions of several plutonium metal and enriched-uranium metal systems are computed and, when possible, the calculated dimensions are compared with experimental values. The computed dimensions are from 2.1 to 5.6 per cent higher than the measured values. This discrepancy is due primarily to the assumption of a uniformly distributed source density. (9 references) (auth)

Reactor Components, Fuels, and Accessories

Refer also to abstracts 33640, 33760, 33830, 33833, 33838, 33851–33853, 34839, 34840, 34843, 34922, 34923, 34969–34975, and 34984.

36091 THERMIONIC FUEL ROD. (to Brown, Boveri and Cie). British Patent 1,188,834. 22 Apr 1970. Priority date 5 Aug 1966, Germany.

A thermionic fuel rod for use with nuclear fuel is described. The rod consists of a number of thermionic elements which are connected in series. The elements consist of tubular emitters located concentrically inside tubular collectors with their discharge spaces and internal bores of the emitters connected by ducts to the discharge spaces and internal bores of adjacent elements. Each thermionic element can be checked before they are assembled, thus eliminating the need to dismantle a completed fuel rod if one cell is faulty. (H.D.R.)

36092 SODIUM FILLED CAPSULES. Hobbs, W. R. (Atomic Energy Research Establishment, Harwell, Eng.). Nucl. Energy; 11: 72-8(May-Jun 1970).

Sodium filled capsules have been used for fissile irradiations for many years. As specimen sizes and heat outputs have increased, capsules have become more sophisticated to meet the problems posed by the more stringent irradiation specifications. Recent capsule design is described, laboratory simulation tests are presented and the in-pile performance of some of special interest is analyzed. (auth) (UK)

36093 THERMAL INSULATION FOR WALLS. Mordchelles-Regnier, George; Naudin, Paul Marcel; Micheau, Pierre Gabriel (to Bertin et Compagnie). British Patent 1,193,450. 3 Jun 1970. Priority date 30 Dec 1966, France.

PRESSURE VESSELS—thermal insulation of reactor prestressed concrete, wall system with trough-like shelves for
REACTORS, BOILING—pressure vessel for, thermal insulation for walls of prestressed concrete
REACTORS, WATER COOLED—pressure vessel for boiling, thermal insulation for walls of prestressed concrete
THERMAL INSULATION—design for prestressed concrete pressure vessel walls (H.D.R.)

36094 FUEL ELEMENT FOR A NUCLEAR REACTOR. Feutrel, Claude (to Commissariat a l'Energie Atomique). British Patent 1,193,817. 3 Jun 1970. Priority date 24 Apr 1968, France.

REACTOR FUEL ELEMENTS—spacer grid for cluster pin type, design of triangular metal (H.D.R.)

36095 NUCLEAR REACTOR. (to Westinghouse Electric Corp.). British Patent 1,193,564. 3 Jun 1970. Priority date 24 Jan 1968, United States.

REACTOR CONTROL ELEMENTS—drives for parallel arranged rod type, description of two position (D.C.C.)

36096 HERMETICALLY-SEALED MOTION TRANSFER UNIT. Cavy, Claude; Rouge, Pierre; Tissot, Roland. (to Commissariat a l'Energie Atomique). British Patent 1,196,227. 24 Jun 1970. Priority date 11 Dec 1967, France.

REACTOR CONTAINMENT STRUCTURES—penetration for remote handling device in description of hermetically sealed
REMOTE-HANDLING EQUIPMENT—penetrations in containment structures for, description of hermetically sealed (D.C.C.)

36097 METHOD OF SEVERING A NUCLEAR FUEL BUNDLE. Freeborg, Robert M. (to Bechtel International Corp.). U. S. Patent 3,514,838. 2 Jun 1970. Filed 15 Jul 1966.

CUTTING TOOLS—design of saw blade, for disassembly of bundle arranged tube type fuel elements
REACTOR FUEL ELEMENTS—disassembly of bundle arranged tube type, design of cutting tools for (D.C.C.)

36098 FUEL SYSTEMS FOR NUCLEAR REACTORS. Nims, John B. Jr. (to Atomic Power Development Associates, Inc.). U. S. Patent 3,515,638. 2 Jun 1970. Filed 12 May 1967.

A nuclear reactor is described which comprises an array of fuel assemblies having tapered cooperating interface surfaces. Longitudinal expansion of the assembly causes radial core expansion. (AEC)

GENERAL

36099 (ANL-7628) SYMBOLIC DERIVATIVE-TAKER FOR A SPECIAL-PURPOSE LANGUAGE FOR LEAST-SQUARES FITS. Gabriel, Marian (Argonne National Lab., Ill.). Feb 1970. Contract W-31-109-eng-38. 72p. Dep. CFSTI.

36100 (ANL-Trans-835) HEAT EXCHANGER WITH FLAT TUBES AND CONTINUOUS FINS. Vladea, Ioan; Theil, Helmut; Neiss, Franz. Translated for Argonne National Lab., Ill., from German report. 14p. Dep. CFSTI.

36101 (ANL-Trans-837) INFLUENCE OF THERMAL CONDUCTION ON THE EFFICIENCY OF A REGENERATOR WITH A MOVING ACCUMULATOR PACKING. Glaser, Helmuth (Stuttgart Univ. (West Germany)). Translated for Argonne National Lab., Ill., from German report. 13p. Dep. CFSTI.

36102 (ANL-Trans-838) HEAT TRANSFER IN REGENERATORS. Traustel, Sergei. Translated for Argonne National Lab., Ill., from German report. 8p. Dep. CFSTI.

36103 (COO-716-56) PREPARATION AND VAPORIZATION THERMODYNAMICS OF EUROPIUM OXIDE BROMIDES. Haschke, John M.; Eick, Harry A. (Michigan State Univ., East Lansing. Dept. of Chemistry). [1970]. 18p. Dep. CFSTI.

36104 (COO-716-57) VAPORIZATION THERMODYNAMICS OF SAMARIUM OXIDE FLUORIDE. Work, Dale E.; Eick, Harry A. (Michigan State Univ., East Lansing. Dept. of Chemistry). [1970]. 16p. Dep. CFSTI.

36105 (COO-1018-1204) A STUDY OF METHODS FOR SELECTION OF QUOTIENT DIGITS DURING DIGITAL DIVISION. Report No. 397. Atkins, Daniel E. (Illinois Univ., Urbana. Dept. of Computer Science). Jun 1970. Contract AT(11-1)-1018. 120p. Dep. CFSTI.
Thesis.

36106 (COO-1018-1206) STANDARDIZATION OF CONTROL POINT REALIZATION. Report No. 400. Martin, Ronald Gustav (Illinois Univ., Urbana. Dept. of Computer Science). May 1970. Contract AT(11-1)-1018. 62p. Dep. CFSTI.
Thesis.

36107 (COO-1140-185) STUDIES OF VAPORIZATION KINETICS OF POTASSIUM CHLORIDE AND RAREFIED GAS FLOW WITH A SPHERICAL EFFUSION CELL. Nordine, Paul C. (Kansas Univ., Lawrence. Dept. of Chemistry). 2 May 1970. Contract AT(11-1)-1140. 303p. Dep. CFSTI.
Thesis.

36108 (COO-1469-162) HIGH ORDER STIFFLY STABLE METHODS FOR ORDINARY DIFFERENTIAL EQUATIONS. Report No. 394. Jain, M. K.; Srivastava, V. K. (Illinois Univ., Urbana. Dept. of Computer Science). Apr 1970. Contract AT-(11-1)-1469. 47p. Dep. CFSTI.

36109 (COO-1469-164) OPTIMAL STIFFLY STABLE METHODS FOR ORDINARY DIFFERENTIAL EQUATIONS. Report No. 402. Jain, M. K.; Srivastava, V. K. (Illinois Univ., Urbana. Dept. of Computer Science). Jun 1970. Contract AT(11-1)-1469. 17p. Dep. CFSTI.

36110 (COO-1469-165) COMPUTER SYSTEMS RESEARCH. Annual Report, September 1, 1969–August 31, 1970. Gear, C. W.; Poppelbaum, W. J. (Illinois Univ., Urbana. Dept. of Computer Science). 102p. Dep. CFSTI.

36111 (COO-1469-166) TEST MATRICES. I. Report No. 403. Fosdick, L. D.; Kim, Y. J. (Illinois Univ., Urbana. Dept. of Computer Science). Jun 1970. Contract AT(11-1)-1469. 36p. Dep. CFSTI.

36112 (COO-1469-167) MULTIPLE PRECISION COMPUTATION OF LEGENDRE FUNCTIONS. Report No. 404. Fleck, Ruth Ann Potts (Illinois Univ., Urbana. Dept. of Computer Science). Jun 1970. 157p. Dep. CFSTI.
Thesis.

36113 (COO-1782-3) A CALORIMETRIC STUDY OF PRUSSIAN BLUE AND TURNBULL'S BLUE FORMATION. Izatt, Reed M.; Watt, Gerald D.; Bartholomew, Calvin H.; Christensen, James J. (Brigham Young Univ., Provo, Utah). 15 May 1970. 9p. Dep. CFSTI.

36114 (LA-4425-TR) STUDY OF THE COMPRESSION OF DENSE MEDIA USING RADIOGRAPHY OF A SINGLE SHOCK WAVE. Dapoigny, J.; Kieffer, J.; Vodar, B. Translated for Los Alamos Scientific Lab., N. Mex., from Compt. Rend.; 245: 1502-5(1957). 3p. Dep. CFSTI.

36115 (LA-tr-70-8) DEPENDENCE OF CRITICAL DIAMETER OF LIQUID EXPLOSIVES ON CONTENT OF POWDERS. Kurbangalina, R. Kh. Translated by Helen Dahlby (Los Alamos Scientific Lab., N. Mex.), from Zh. Prikl. Mekh. Tekh. Fiz.; No. 4, 133-6(1969). 8p. Dep. CFSTI.

36116 (NYO-2269-14) STUDIES IN SOLUTION AND NUCLEAR CHEMISTRY. Progress Report, October 1, 1969–September 30, 1970. Marinsky, Jacob A. (State Univ. of New York, Buffalo. Dept. of Chemistry). 1 Jul 1970. Contract AT(30-1)-2269. 89p. Dep. CFSTI.

36117 (NYO-3497-23) ECOLOGY OF PODON POLYPHEMOIDES (CRUSTACEA, BRANCHIPODA) IN THE CHESAPEAKE BAY. Technical Report 66. Bosch, Herman F.; Taylor, W. Rowland (Johns Hopkins Univ., Baltimore, Md. Chesapeake Bay Inst.). May 1970. Contract AT(30-1)-3497. 77p. Dep. CFSTI.

36118 (NYO-3588-21) NUCLEIC ACIDS AND PROTEIN SYNTHESIZING MECHANISMS OF MITOCHONDRIA. Annual Progress Report. Suyama, Yoshitaka (Pennsylvania Univ., Philadelphia. Dept. of Biology). [1969]. Contract AT(30-1)-3588. 18p. Dep. CFSTI.

36119 (ORNL-TM-3042) ORNL BASIC COMPILER. Sullivan, J. G.; Stockton, J. R. (Oak Ridge National Lab., Tenn.). Jul 1970. Contract W-7405-eng-26. 24p. Dep. CFSTI.

36120 (ORO-3736-8) A SPECTROSCOPIC AND PHOTOCHEMICAL STUDY OF VISION PIGMENTS AND OTHER ORGANIC MOLECULES. Annual Progress Report, October 15, 1969–October 14, 1970. Becker, Ralph S. (Houston Univ., Tex. Dept. of Chemistry). 1 Jul 1970. Contract AT(40-1)-3736. 47p. Dep. CFSTI.

36121 (RLO-1725-167) RELEASE OF DISSOLVED ORGANIC MATTER BY MARINE PHYTOPLANKTON IN COASTAL AND OFFSHORE AREAS OF THE NORTHEAST PACIFIC OCEAN. Anderson, G. C.; Zeutschel, R. P. (Washington Univ., Seattle. Dept. of Oceanography). [1969]. 14p. Dep. CFSTI.

36122 (RLO-1725-174) BENTHIC INFAUNA COMMUNITIES OFF THE COAST OF WASHINGTON AND IN PUGET SOUND: SPECIES COMPOSITION AND STRUCTURE OF THE OFFSHORE COMMUNITIES. Lie, Ulf; Kisker, Dale S. (Washington Univ., Seattle. Dept. of Oceanography). [1970]. 35p. Dep. CFSTI.

36123 (RLO-2212-4) THE PHOTOBIOLOGY AND PHOTOCHEMISTRY OF RIBONUCLEIC ACIDS. Progress Report, April 1, 1969–March 31, 1970. Gordon, Milton P. (Washington Univ., Seattle). Contract AT(45-1)-2212. 11p. Dep. CFSTI.

36124 (RLO-2217-1) STUDIES ON THE CONTROL OF CELL WALL EXTENSION. Progress Report, June 1, 1969–January 31, 1970. Cleland, Robert (Washington Univ., Seattle). Contract AT(45-1)-2217. 6p. Dep. CFSTI.

36125 (RLO-2225-T-7-3) FERN LAKE MINERAL METABOLISM PROGRAM. Annual Progress Report. Donaldson, Lauren R. (Washington Univ., Seattle. Coll. of Fisheries). 16 Jun 1970. Contract AT(45-1)-2225. 21p. Dep. CFSTI.

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